

TEST SERVICES

TEST REPORT #: Q03463

DATE: September 18, 2003

TITLE: Emissions Test of the Smart UPS RT Transformer

Model: SURT001 and SURT002

Serial Number: Proto 2

STANDARDS:

EN50091-2, 1996, Uninterruptible Power Systems (UPS), Class A Emissions


EN55022, 1998, Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment, Class A

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SECTION 1 OVERVIEW

1.1 Purpose of Test

To determine if the Smart UPS RT Transformer will meet the EN55022 Class A requirements for radiated and conducted emissions.

1.2 Date of Test

September 10, 2003

1.3 Statement of Compliance

The Smart UPS RT Transformer unit that was tested and referenced in this test report was found to comply with the requirements of:

EN55022, Class A

SECTION 2 REFERENCES

2.1 Procedures/Standards

- ° CISPR Publication 22, 1993, Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment
- ° EN55022, 1998, Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment
- ° Namas NIS 81, Edition 1, May 1994, The Treatment of Uncertainty in EMC Measurements

2.2 Deviations from Standards

None

SECTION 3 DETAILS

3.1 Description of Product

The Equipment Under Test (EUT) consisted of a single unit, the Smart UPS RT Transformer. Model SURT002. The SURT001 is the same unit with a lower current rating.

The EUT was configured as given 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

The test setup was per the procedures and standards referenced in section 2.1. The voltage supplied to the EUT was 230 VAC, 50 Hz. All support equipment was powered by 120 VAC/60Hz.

Radiated Test

The EUT was installed on the 80 cm high wooden table on the five meter diameter turntable which is located in the protective dome area of the Free Field Site (FFS). A 10-meter distance was used for EUT to antenna separation. The free field ground plane consists of a uniform wire mesh 12 meters wide and 42 meters long. The product was scanned from 1-4 meters in height and 360 degrees around it. The frequency range scanned was from 30 to 1000 MHz for all configurations. All test equipment was kept below the ground plane with the exception of the antenna and associated cables required for measurements. The cable positioning, antenna height/polarization, and turntable orientation were all chosen to maximize the emissions in order to represent a worst case condition.

Conducted Test

The EUT was installed on the 80 cm high wooden table in the FFS conducted emissions test area. A 40 cm distance between the vertical plane and the EUT was maintained. Measurements were made to determine the levels of RF noise induced into the AC power line. Power for the EUT was supplied via a filter bank and a Line Impedance Stabilization Network (LISN). The LISN was electrically bonded to the ground plane. The frequency range scanned was from 10 kHz to 30 MHz. All support equipment was powered via separate LISNs. Hand written Average readings have 10dB added to account for the 10dB surge protector this is automatically accounted for in the software as part of the measurement process.

Test Equipment Used

Date of Calibration

EMCO Biconilog Antenna (30-1000 MHz) Model 3143, s/n 1118.....	10/02
HP8566B Spectrum Analyzer, s/n 2928A05991.....	2/03
HP85662A Display Section, s/n 2848A17920.....	2/03
HP85650A Quasi Peak Adapter, s/n 2430A00452.....	2/03
HP85685A RF Preselector, s/n 2620A00342.....	2/03
HP11947A Transient Limiter, s/n 2820A00193.....	2/03
EMCO LISN, 50 Ohm, Single Phase, 25 Amp, DC/50/60 Hz, s/n 1296 (for EUT).....	3/03
EMCO LISN, 50 Ohm, Single Phase, 25 Amp, DC/50/60 Hz, s/n 1291 (for support equipment)...	3/03
Bull 10 meter Cable s/n FFS10M.....	2/03
Bull LISN Cable s/n FFSLISN.....	2/03
HP98580A Technical Computer Model 310	
REMS Software Radiated Emissions	
EMI Software Conducted Emissions	

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

Test Environment: Temp.= 71°F, Relative Humidity = 40%

3.4 Pictures



Configuration for Radiated Emissions (Front Closeup)



Configuration for Radiated Emissions (Front)

3.4 Pictures



Configuration for Radiated Emissions (Rear Closeup)



Configuration for Radiated Emissions (Rear)

3.4 Pictures (continued)



Configuration for Conducted Emissions



Support Equipment

SECTION 4 CONCLUSIONS**4.1 Summary of Test Results**

EN55022, Class A: **Passed**

4.2 Special Notes

The test engineer was D. Kutz.

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.

This report must not be used by the customer to claim product endorsement by NVLAP or any agency of the U.S. Government.

4.3 Required Compliance Modifications

None

SECTION 5 DATA**5.1 Data Table Explanation/Calculation**

SPEC LIMIT - specification limit at 10 meters for CISPR 22 Class A

ABS - final reading including antenna factor and cable loss

dLIM - ABS relativity to the SPEC LIMIT calculated as follows:

$$dLIM = ABS - SPEC LIMIT \text{ [dB]}$$

MODE - measurement detector mode, QP: Quasi-peak, P: Peak

POL - antenna polarity, H: Horizontal, V: Vertical

HGT - antenna height in centimeters

AZM - turntable angle in degrees

CORR FACTOR - correction factor includes antenna factor and cable loss

The CORR FACTOR is used to determine the ABS as follows:

$$CORR FACTOR \text{ [dB/m]} = ANTENNA FACTOR \text{ [dB/m]} + CABLE LOSS \text{ [dB]}$$

$$ABS \text{ [dB}\mu\text{V/m]} = ACTUAL MEASUREMENT \text{ [dB}\mu\text{V]} + CORR FACTOR \text{ [dB/m]}$$

Assume a receiver reading of 23.5 dB μ V is obtained. The antenna factor of 7.4 dB/m and a cable factor of 1.1 dB is added, giving a field strength (FS) of 32 dB μ V/m.

$$FS = 23.5 \text{ [dB}\mu\text{V]} + 7.4 \text{ [dB/m]} + 1.1 \text{ [dB]} = 32.0 \text{ [dB}\mu\text{V/m]}$$

The 32.0 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } ((32.0 \text{ dB}\mu\text{V/m})/20) = 39.8 \text{ } \mu\text{V/m}$$

5.2 Measurement Uncertainty

Reference: Namas NIS 8, Edition 1, May 1994 The Treatment of Uncertainty in EMC Measurements			
Radiated Emissions			
(using the EMCO Biconilog Antenna Model 3143, frequency range of 30-1000 MHz at 10 meter test distance)			
Contribution	Probability Distribution	Uncertainty (dB) (+)	Uncertainty (dB) (-)
Antenna Factor Calibration	normal (k=2)	1.00	-1.00
Cable Loss Calibration	normal (k=2)	0.50	-0.50
Receiver Specification:			
HP8566B Spectrum Analyzer	rectangular	0.60	-0.60
HP85685A RF Preselector	rectangular	1.60	-1.60
Antenna directivity worst-case, 1 GHz @ 4m height	rectangular	2.00	0.00
Antenna factor variation with height	rectangular	0.50	-0.50
Antenna phase center variation	rectangular	0.50	-0.50
Antenna factor frequency interpolation	rectangular	0.25	-0.25
Measurement distance variation	rectangular	0.50	-0.50
Site imperfections	rectangular	1.00	-1.00
Mismatch:			
Receiver VRC:			
Antenna VRC:	U-shaped	0.50	-0.50
Uncertainty limits			
System repeatability	Std Deviation	0.50	-0.50
Combined standard uncertainty, $u_c(y)$	normal	1.8969	-1.1365
Expanded uncertainty, U	normal (k=2)	3.79	-2.27
Conducted Emissions			
(using the EMCO 3825 LISNs, frequency range of 9kHz - 30MHz)			
Contribution	Probability Distribution	Uncertainty (dB) (+/-)	
Receiver Specification			
HP8566B Spectrum Analyzer	rectangular	0.60	
HP85685A RF Preselector	rectangular	1.60	
LISN coupling specification: insertion loss uncertainty which includes LISN to LISN and Line to Line	rectangular	1.50	
Cable and input attenuator calibration	normal (k=2)	0.30	
Mismatch:			
Receiver VRC:			
Antenna VRC:	U-shaped	0.20	
Uncertainty limits			
System repeatability	Std Deviation	0.20	
Combined standard uncertainty, $u_c(y)$	normal	1.3438	
Expanded uncertainty, U	normal (k=2)	2.69	
Use of the uncertainty calculation:			
Measurement results are: y dBuV +/- U dB for a level of confidence of approximately 95% (k=2)			

5.3 Radiated E Field Emissions Data

QUEST ENGINEERING
FREE FIELD TEST FACILITY
TEST REPORT DATA

DATE: 09/10/03

TIME: 12:10

EUT DESCRIPTION: APC 5KVA TRANSFORMER WITH 230VAC/50HZ INPUT VOLTAGE
AND FULL LOAD CHARGING.

TYPE TEST: RADIATED E FIELD EMISSIONS EN55022 CLASS A @10M

FREQUENCY RANGE: 30-1000 MHz

SUPPORT EQUIP. DESCRIPTION: SEE REPORT

TEST PERFORMED BY: D. KUTZ

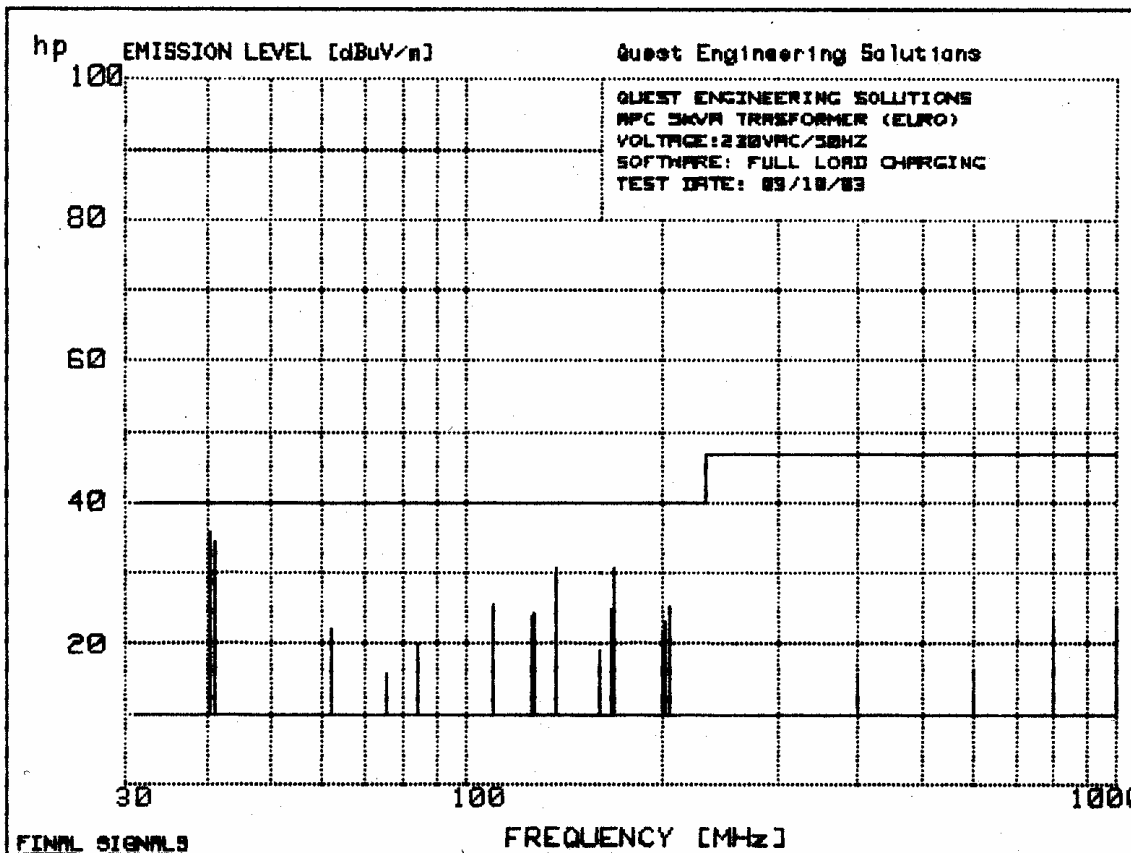
TEST RESULTS: PASS

PRODUCT EMISSIONS

QUEST ENGINEERING SOLUTIONS

Data File: 30-1000MHZ @10M 10 Sep 2003 11:59

No	EMISSION FREQUENCY MHz	SPEC LIMIT dBuV/m	MEASUREMENTS			SITE			CORR FACTOR dB	COMMENTS
			ABS	dLIM	MODE	POL	HGT	AZM		
				dB		cm	deg			
1	39.342	40.0	35.9	-4.1	QP	U	108	245	10.1	BROADBAND
2	40.014	40.0	34.5	-5.5	QP	U	108	245	9.9	BROADBAND
3	60.553	40.0	22.4	-17.6	PK	U	108	0	N/T	BROADBAND
4	73.676	40.0	15.9	-24.1	PK	U	108	0	N/T	BROADBAND
5	82.527	40.0	20.0	-20.0	PK	U	108	0	N/T	BROADBAND
6	108.428	40.0	25.6	-14.4	PK	U	108	315	N/T	BROADBAND
7	124.145	40.0	24.1	-15.9	PK	U	108	180	N/T	BROADBAND
8	125.604	40.0	24.5	-15.6	PK	U	108	180	N/T	BROADBAND
9	135.142	40.0	30.8	-9.2	QP	U	108	180	10.3	BROADBAND
10	157.262	40.0	19.3	-20.7	PK	U	108	180	N/T	BROADBAND
11	164.997	40.0	25.1	-14.9	PK	U	108	315	N/T	BROADBAND
12	166.252	40.0	30.8	-9.2	QP	U	108	345	11.	BROADBAND
13	196.875	40.0	21.8	-18.2	PK	U	108	175	N/T	BROADBAND
14	199.993	40.0	23.2	-16.8	PK	U	108	90	N/T	BROADBAND
15	203.22	40.0	25.2	-14.8	PK	U	108	90	N/T	BROADBAND
16	399.36	47.0	15.9	-31.1	PK	U	108	90	N/T	AMB NOISE FLOOR
17	603.72	47.0	16.6	-30.4	PK	U	108	90	N/T	AMB NOISE FLOOR
18	802.02	47.0	24.2	-22.8	PK	H	108	90	N/T	AMB NOISE FLOOR
19	998.5	47.0	25.0	-22.1	PK	H	108	90	N/T	AMB NOISE FLOOR



Radiated E Field Emissions CISPR 22, Class A @ 10 meters

5.4 Conducted Emissions Data

QUEST ENGINEERING SOLUTIONS, INC.
 FREE FIELD TEST FACILITY
 CONDUCTED EMISSIONS TEST RESULTS

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10 Sep 2003 13:35:48

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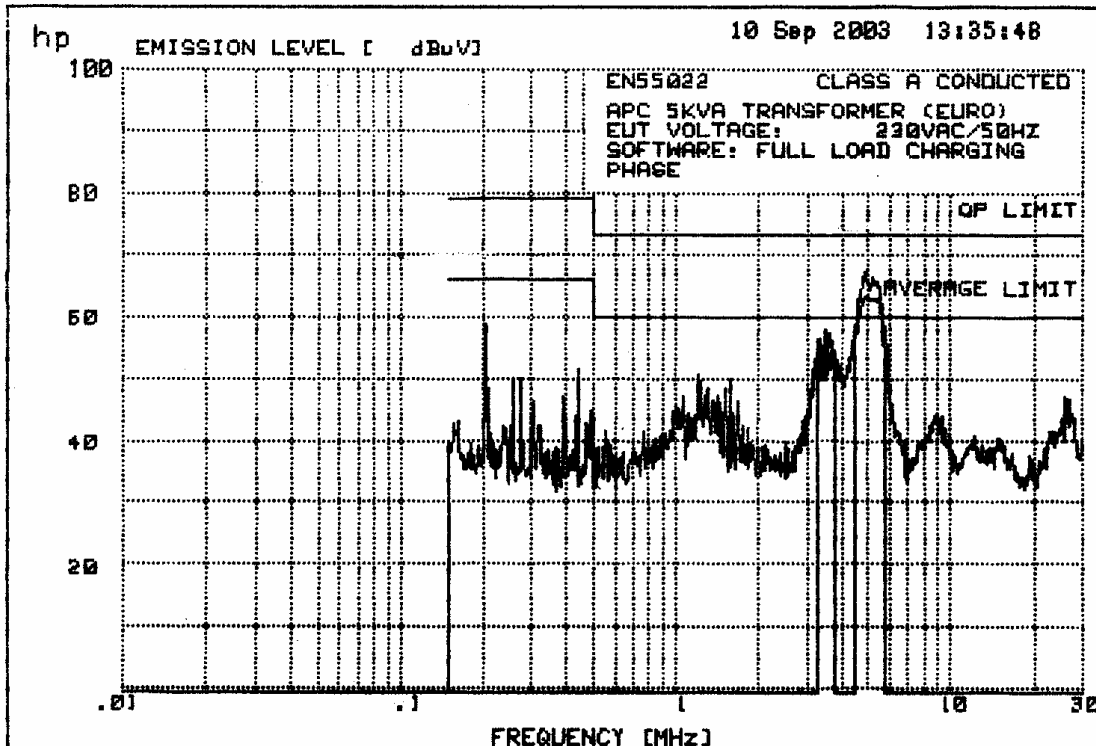
1.
 1.1 EN55022 CLASS A CONDUCTED

=====

APC 5KVA TRANSFORMER (EURO)
 EUT VOLTAGE: 230VAC/50HZ
 SOFTWARE: FULL LOAD CHARGING
 PHASE

10 highest peaks above -40 dB of Limit Line #2 Average
 peak criteria = 1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	.2056	58.7	-7.3
2	3.195	53.2	-6.8
3	3.273	56.2	-3.8
4	3.352	56.2	-3.8
5	3.434	55.2	-4.8
6	3.517	57.8	-2.2
7	3.574	57	-3.0
8	3.661	57.1	-2.9
9	4.843	66.9	6.9
10	5.205	66.4	6.4



QUEST ENGINEERING SOLUTIONS, INC.
 FREE FIELD TEST FACILITY
 CONDUCTED EMISSIONS TEST RESULTS

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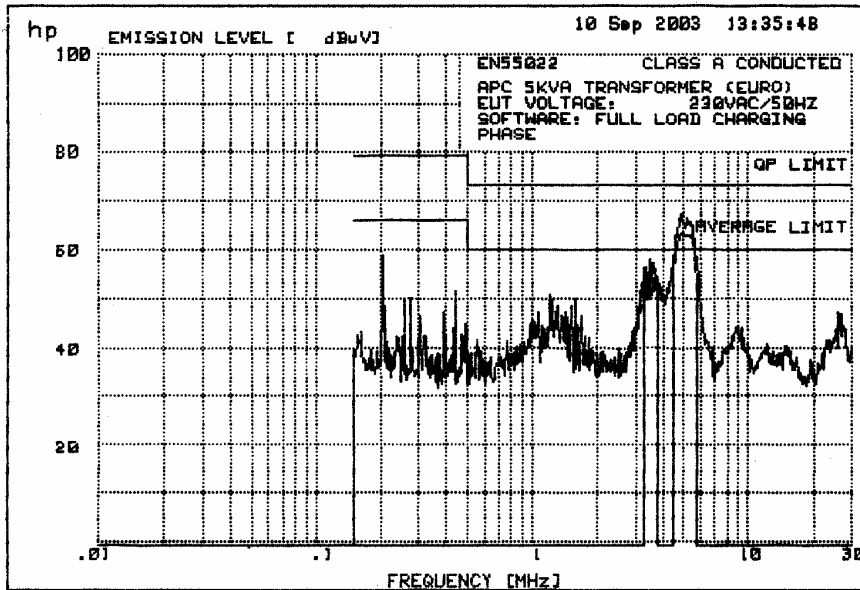
1. 1.1 EN55022 CLASS A CONDUCTED

APC 5KVA TRANSFORMER (EURO)
 EUT VOLTAGE: 230VAC/50HZ
 SOFTWARE: FULL LOAD CHARGING
 PHASE

10 highest quasi-peaks above -40 dB of Limit Line #2 Average
 peak criteria = 1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	3.299	53.4	-6.6
2	3.379	53.3	-6.7
3	3.434	53.1	-6.9
4	3.517	53.4	-6.6
5	3.603	53.9	-6.1
6	3.69	54.2	-5.8
7	3.749	53.2	-6.8
8	4.843	63	3.0

Avg = 47.19 + 10 = 57.2, Limit 60, Margin -2.8



QUEST ENGINEERING SOLUTIONS, INC.
 FREE FIELD TEST FACILITY
 CONDUCTED EMISSIONS TEST RESULTS

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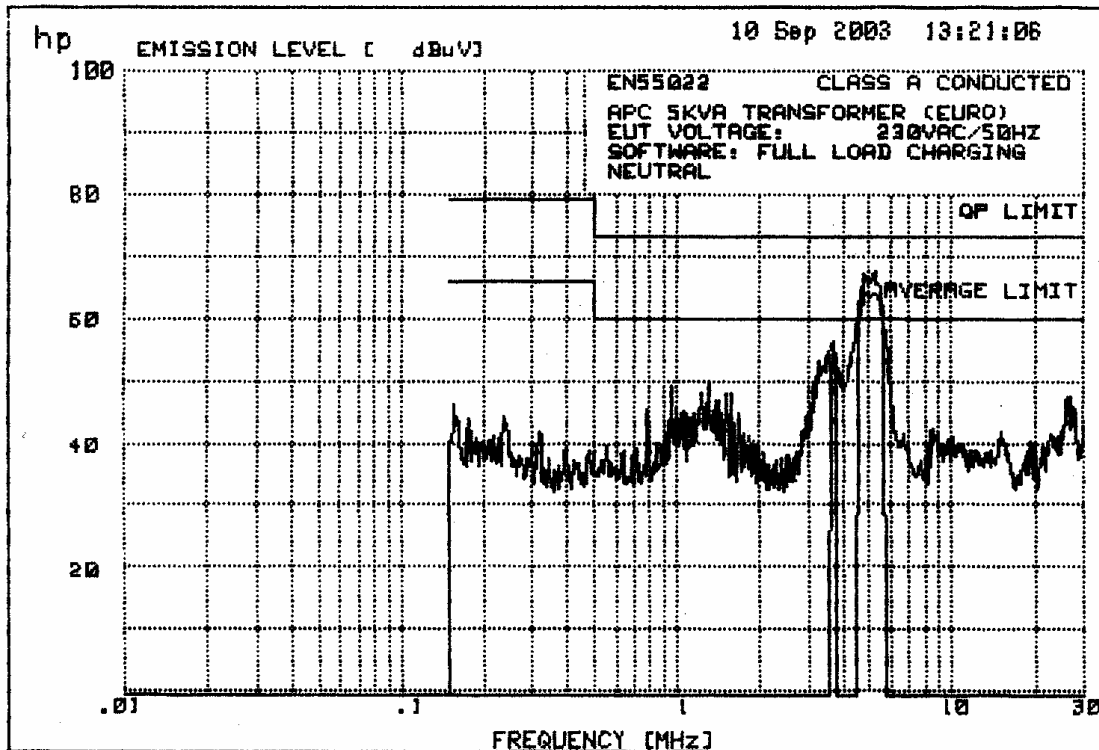
1.
 1.1 EN55022 CLASS A CONDUCTED

APC 5KVA TRANSFORMER (EURO)
 EUT VOLTAGE: 230VAC/50HZ
 SOFTWARE: FULL LOAD CHARGING
 NEUTRAL

10 highest peaks above -40 dB of Limit Line #2
 peak criteria = 1 dB

Average

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	.9549	49.1	-10.9
2	1.305	49.8	-10.2
3	1.593	48	-12.0
4	3.145	49.6	-10.4
5	3.299	53.2	-6.8
6	3.69	56.1	-3.9
7	3.902	51.8	-8.2
8	3.997	50.7	-9.3
9	4.766	67.1	7.1
10	5.289	67.3	7.3



QUEST ENGINEERING SOLUTIONS, INC.
 FREE FIELD TEST FACILITY
 CONDUCTED EMISSIONS TEST RESULTS

10 Sep 2003 13:21:06

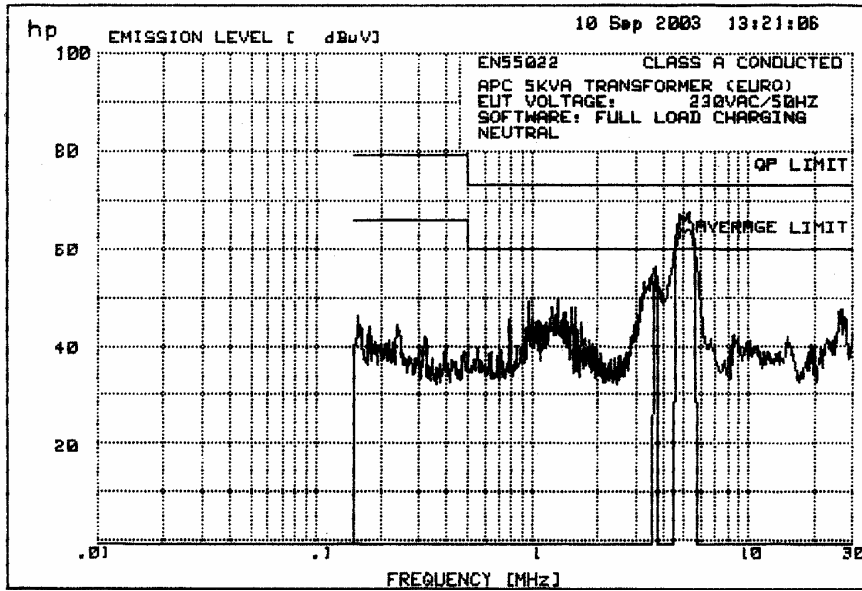
1. 1.1 EN55022 CLASS A CONDUCTED

APC 5KVA TRANSFORMER (EURO)
 EUT VOLTAGE: 230VAC/50HZ
 SOFTWARE: FULL LOAD CHARGING
 NEUTRAL

10 highest quasi-peaks above -40 dB of Limit Line #2 Average
 peak criteria = 1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	3.603	52.8	-7.2
2	3.69	53.5	-6.5
3	3.749	52.6	-7.4
4	5.205	64	4.0

Avg = 48.24 + 10 = 58.2, limit 60, Margin -1.8



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"/>
AUDEL	<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"/>
EN61326	<input type="checkbox"/>	EN61000-6-2	<input type="checkbox"/>
EN61000-4-2	<input checked="" type="checkbox"/>	EN61000-4-6	<input checked="" type="checkbox"/>
EN61000-4-3	<input checked="" type="checkbox"/>	EN61000-4-8	<input checked="" type="checkbox"/>
EN61000-4-4	<input checked="" type="checkbox"/>	EN61000-4-11	<input checked="" type="checkbox"/>
EN61000-4-5	<input checked="" type="checkbox"/>		
Special: <u>EN50092-1 EMC for UPS's and BSMI certification</u>		IEC60601-1-2	<input type="checkbox"/>
		Other _____	
		Test Level 1	<input type="checkbox"/>
		Test Level 2	<input type="checkbox"/>
		Test Level 3	<input type="checkbox"/>
		Test Level 4	<input type="checkbox"/>

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, gasketing, 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.

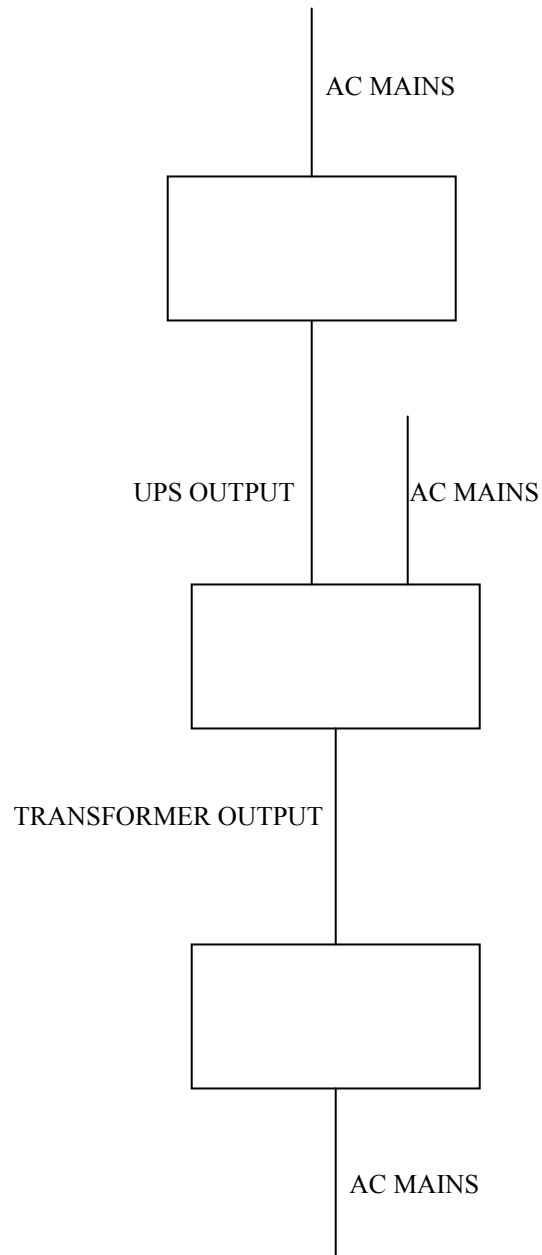
No Software Required

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: Q03463

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 U.S. 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: Q03463. Quest Engineering Solutions acknowledges that the Equipment Under Test was found to have passed the following standards:

**EN55022, 1998, Limits and Methods of Measurement of Radio
Disturbance Characteristics of Information Technology Equipment,
Class A**

Q03463

TEL 978-667-7000 ◆ FAX 978-667-3388 ◆ Email info@QES.com
World Wide Web <http://www.QES.com>