



TEST SERVICES

TEST REPORT #: Q02140

DATE: August 19, 2002

TITLE: Emissions Test of the Uninterruptible Power System

Model: SUA1000RMI1U and SUA750RMI1U
Serial Number: N/A

STANDARDS:

EN50091-2, Uninterruptable Power Systems (UPS)

EN55022, 1994, Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment, Class A

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NVLAQ

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SECTION 1 OVERVIEW

1.1 Purpose of Test

To determine if the Uninterruptible Power System will meet the EN55022 Class A requirements for radiated and conducted emissions.

1.2 Date of Test

August 19, 2002

1.3 Statement of Compliance

The Uninterruptible Power System 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

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 Uninterruptible Power System.

The EUT was configured as given in Appendix A.

3.2 Test Software/Operating Mode

No Software Required

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.

Test Equipment Used

Date of Calibration

EMCO Biconilog Antenna (30-1000 MHz) Model 3143, s/n 1118.....	10/01
HP8566B Spectrum Analyzer, s/n 2928A05991.....	2/02
HP85662A Display Section, s/n 2848A17920.....	2/02
HP85650A Quasi Peak Adapter, s/n 2430A00452.....	2/02
HP85685A RF Preselector, s/n 2620A00342.....	2/02
HP11947A Transient Limiter, s/n 2820A00193.....	1/02
EMCO LISN,50 Ohm,Single Phase,25 Amp,DC/50/60 Hz,s/n 1291(for EUT).....	3/02
EMCO LISN,50 Ohm,Single Phase,25 Amp,DC/50/60 Hz,s/n 1290(for support equipment)...	3/02
Bull 10 meter Cable s/n FFS10M.....	1/02
Bull LISN Cable s/n FFSLISN.....	1/02
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.= 68°F, Relative Humidity = 48%

3.4 Pictures



Configuration for Radiated Emissions (Front Closeup)



Configuration for Radiated Emissions (Front)

3.4 Pictures



Configuration for Radiated Emissions (Rear Closeup)

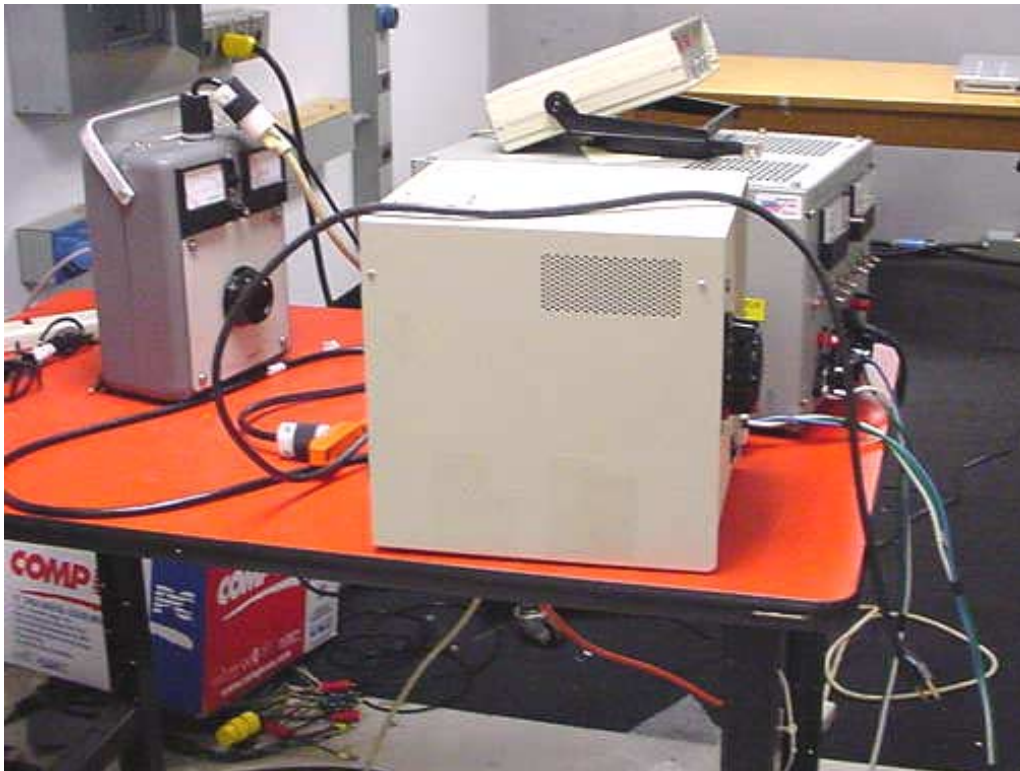


Configuration for Radiated Emissions (Rear)

3.4 Pictures (continued)



Configuration for Conducted Emissions



Support Equipment

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

FCC, Class A: **Passed**

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

Ferrite beads added to transformer output and inverter leads.

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.

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

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			
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: v dBuV +/- U dB for a level of confidence of approximately 95% (k=2)			

5.3 Radiated E Field Emissions Data

FREE FIELD TEST FACILITY
TEST REPORT DATA

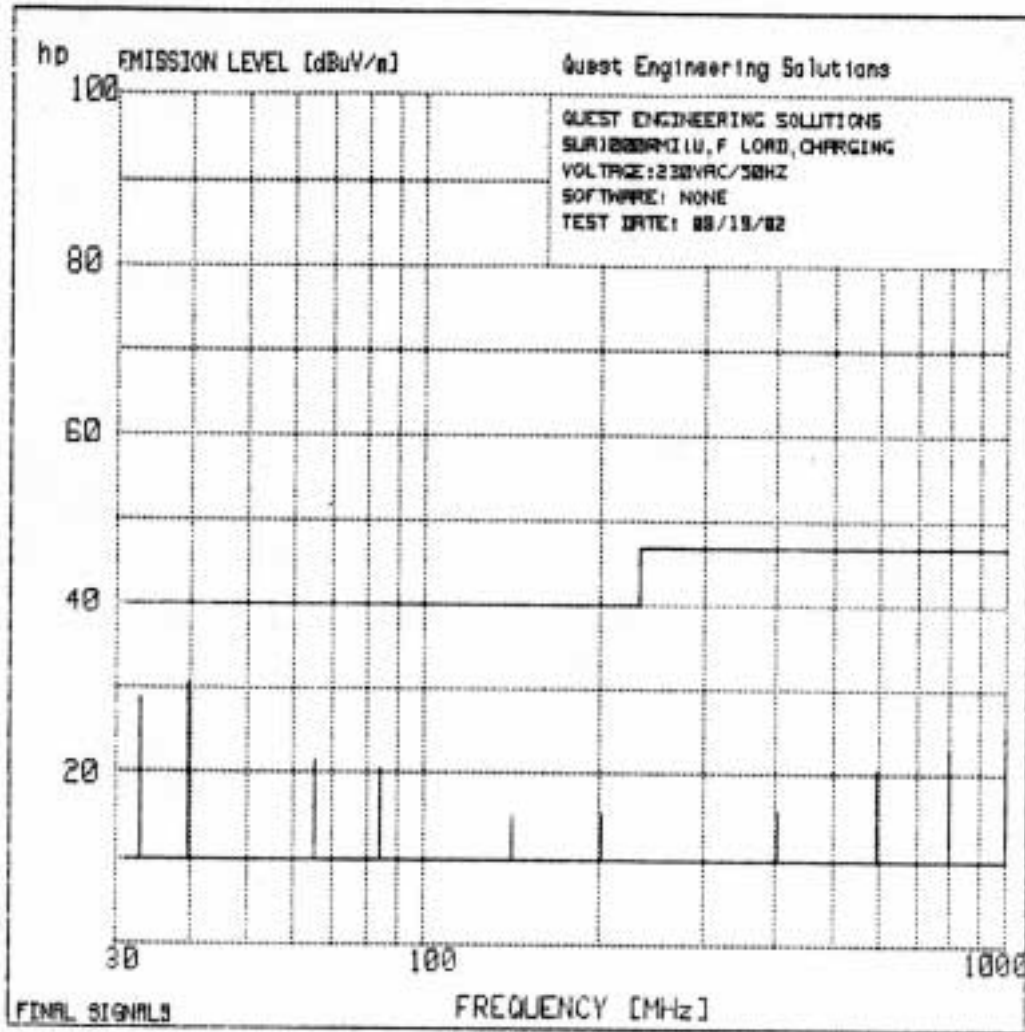
DATE: 08/19/02 TIME: 14:40
 EUT DESCRIPTION: SUA1000RM11U W/ FULL LOAD AND BATTERY CHARGING
 TYPE TEST: RADIATED E FIELD EMISSIONS EN55022 CLASS A @10M
 FREQUENCY RANGE: 30-1000 MHz
 SUPPORT EQUIP. DESCRIPTION: SEE REPORT
 TEST PERFORMED BY: D. KUTZ
 TEST RESULTS: PASS

PRODUCT EMISSIONS

QUEST ENGINEERING SOLUTIONS Date File: 30-1000MHZ @10M 19 Aug 2002 14:28

No	EMISSION FREQUENCY MHz	SPEC LIMIT dBuV/m	MEASUREMENTS			SITE		CORR FACTOR dB	COMMENTS
			ABS	dLIM	MODE	POL	HGT cm		
1	32.001	40.0	28.0	-11.2	QP	U	108 330	11.5	
2	38.705	40.0	30.7	-9.3	QP	U	108 330	10.3	BROADBAND
3	64.002	40.0	21.6	-18.5	PK	U	108 330	N/T	
4	82.461	40.0	20.5	-19.5	PK	U	108 330	N/T	BROADBAND
5	139.74	40.0	15.2	-24.8	PK	U	108 330	N/T	AMB NOISE FLOOR
6	200.13	40.0	15.6	-24.4	PK	U	108 330	N/T	AMB NOISE FLOOR
7	399.57	47.0	15.7	-31.4	PK	U	108 330	N/T	AMB NOISE FLOOR
8	599.29	47.0	20.6	-26.5	PK	U	108 330	N/T	AMB NOISE FLOOR
9	802.95	47.0	23.1	-23.9	PK	U	108 330	N/T	AMB NOISE FLOOR
10	998.5	47.0	25.7	-21.3	PK	U	108 330	N/T	AMB NOISE FLOOR

N/T in CORR FACTOR column denotes a non-traceable signal.



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

5.4 Conducted Emissions Data

FREE FIELD TEST FACILITY
CONDUCTED EMISSIONS TEST RESULTS

19 Aug 1902 09:25:21

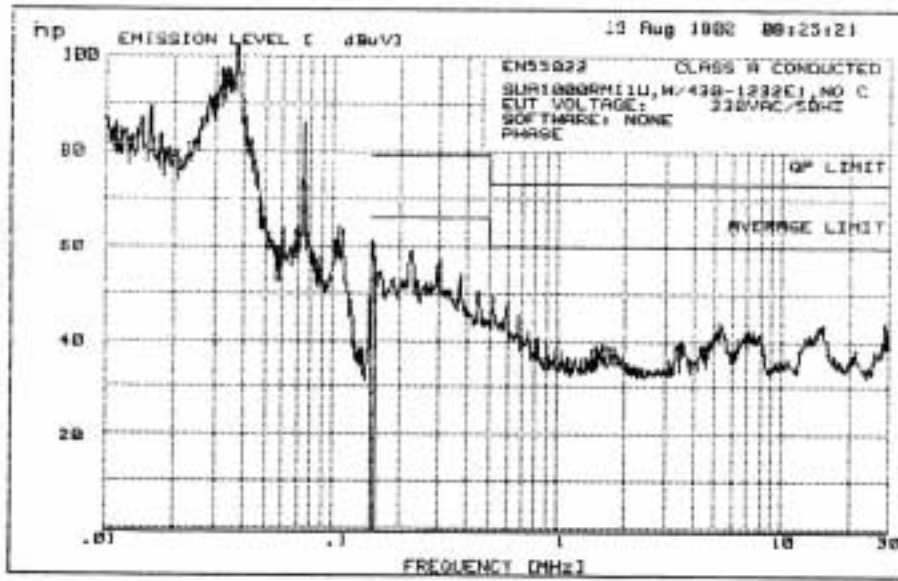
1. CONDUCTED
1.2 EN55022 CLASS A CONDUCTED

SUA1000RM11U, W/430-1232E1, NO C
EUT VOLTAGE: 230VAC/50HZ
SOFTWARE: NONE
PHASE

10 highest peaks above -30 dB of Limit Line #2
peak criteria = 1 dB

PEAK#	FREQ (MHz)	(dB μ V)	DELTA
1	.03713	102.3	DARRNG -27.7
2	.03772	102.3	DARRNG -27.7
3	.1505	61.6	-4.4
4	.167	54.8	-11.2
5	.1868	53	-13.0
6	.2073	52.5	-13.5
7	.2263	59	-7.0
8	.2413	52.5	-13.5
9	.3018	52.1	-8.9
10	.3716	54.1	-11.9

← QP = -6.3



FREE FIELD TEST FACILITY
 CONDUCTED EMISSIONS TEST RESULTS

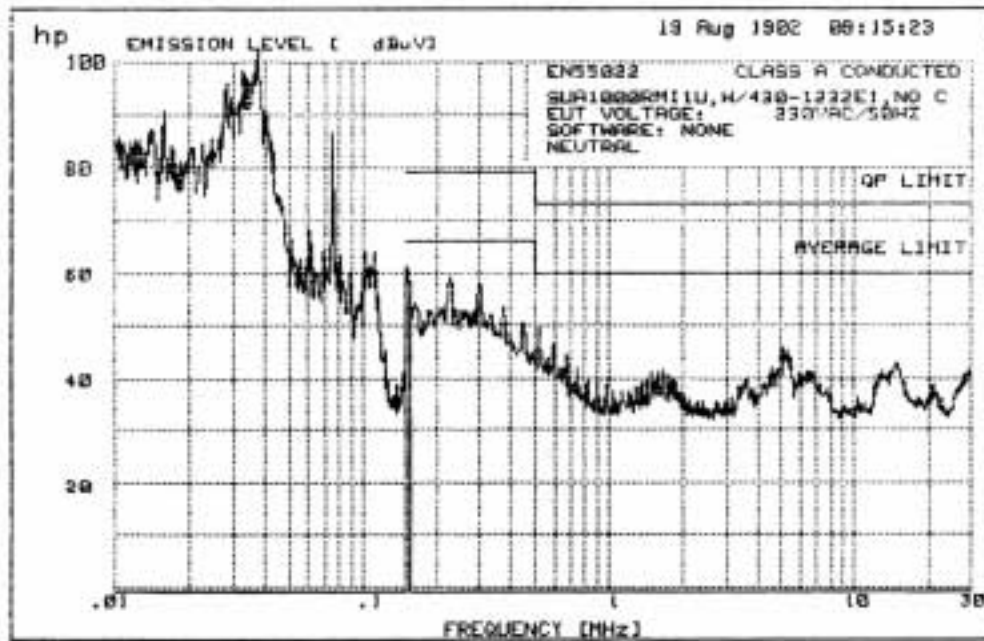
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1. CONDUCTED
 1.2 EN55022 CLASS A CONDUCTED

SUA1000RM11U.W/430-1232E1, NO C
 EUT VOLTAGE: 230VAC/50HZ
 SOFTWARE: NONE
 NEUTRAL

10 highest peaks above -30 dB of Limit Line #2
 peak criteria = 1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	.03772	102.3 OVRNG	-27.7
2	.1505	61	-5.0 ← QP = -6.1
3	.1617	54.3	-11.7
4	.1853	52.8	-13.2
5	.2089	53.2	-12.8
6	.2281	59.1	-6.9
7	.2394	53.2	-12.8
8	.2854	52.8	-13.2
9	.2994	57.6	-8.4
10	.3776	53.5	-12.5



FREE FIELD TEST FACILITY
 CONDUCTED EMISSIONS TEST RESULTS

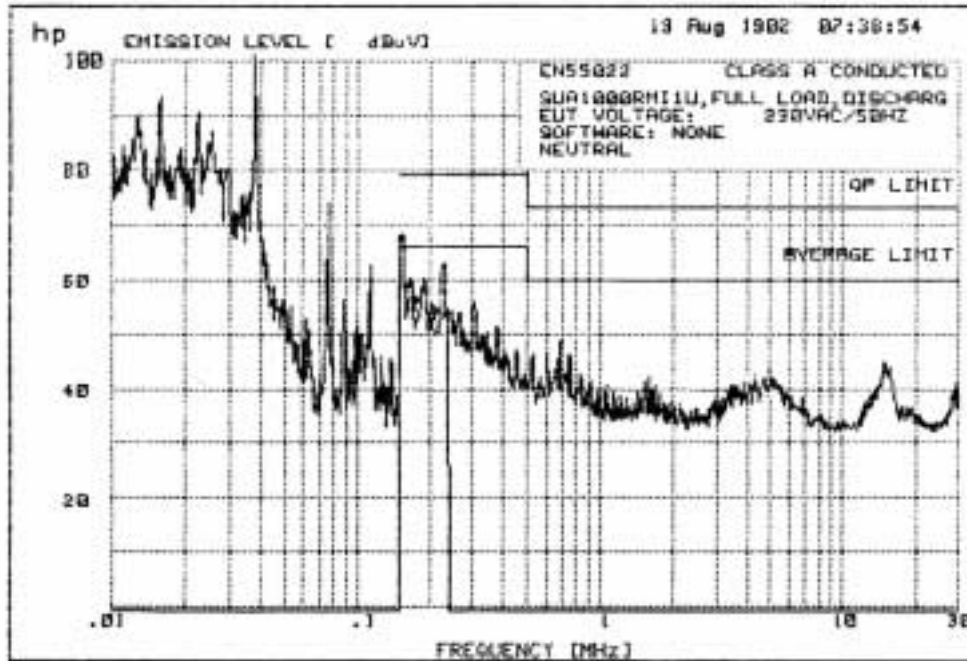
19 Aug 1902 07:38:54

1. CONDUCTED
 1.2 EN55022 CLASS A CONDUCTED

SUA1000RM11U, FULL LOAD, DISCHARG
 EUT VOLTAGE: 230VAC/50HZ
 SOFTWARE: NONE
 NEUTRAL

10 highest peaks above -30 dB of Limit Line #2
 peak criteria = 1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	.03833	100.8 OVRNG	-29.2
2	.1517	68.3	2.3
3	.167	60.1	-5.9
4	.1724	56.9	-9.1
5	.1898	60.2	-5.8
6	.2007	55.6	-10.4
7	.2056	56	-10.0
8	.2106	55	-11.0
9	.2263	62.7	-3.3
10	.3067	56	-10.0



FREE FIELD TEST FACILITY
CONDUCTED EMISSIONS TEST RESULTS

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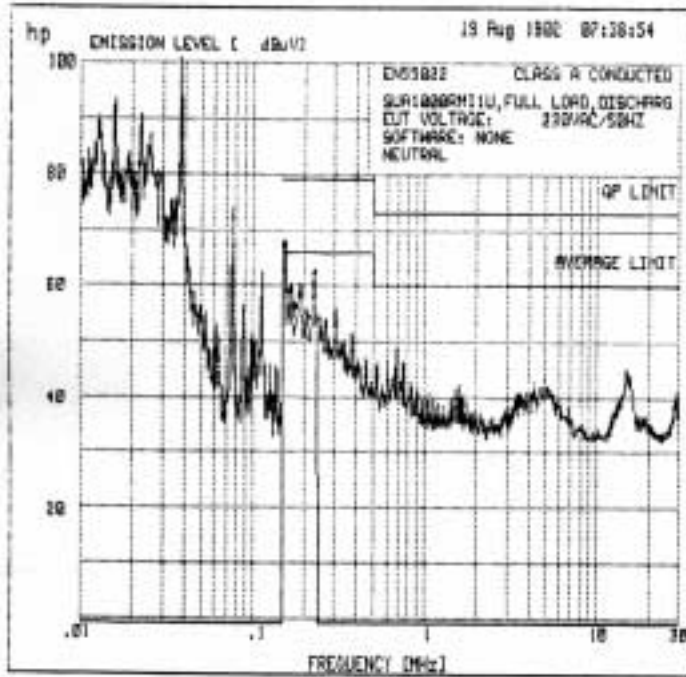
1. CONDUCTED
1.2 EN65022 CLASS A CONDUCTED

SUR1000RM11U, FULL LOAD DISCHRG
EUT VOLTAGE: 230VAC/50HZ
SOFTWARE: NONE
NEUTRAL

10 highest quasi-peaks above -30 dB of Limit Line #2
peak criteria = 1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	.1542	67.6	1.6
2	.167	56.8	-9.2
3	.1898	58.8	-7.2
4	.2017	54	-12.8
5	.2281	62.5	-3.5

avg = 57.08 + 10 = 57.1 dBuV (limit = 66 dBuV Margin = -8.9 dB)



FREE FIELD TEST FACILITY
 CONDUCTED EMISSIONS TEST RESULTS

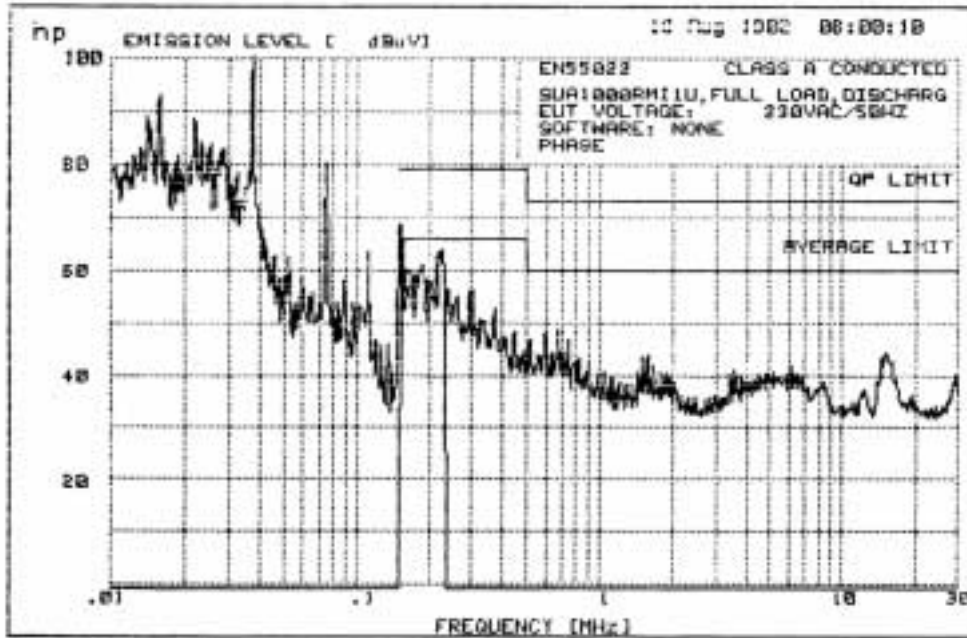
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1. CONDUCTED
 1.2 EN55022 CLASS A CONDUCTED

SUA1000RM11U, FULL LOAD, DISCHARG
 EUT VOLTAGE: 230VAC/50HZ
 SOFTWARE: NONE
 PHASE

10 highest peaks above -30 dB of Limit Line #2
 peak criteria = 1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	.03772	100.2 OVRNG	-29.8
2	.1517	68.8	2.8
3	.1605	60.1	-5.9
4	.1711	58.3	-7.7
5	.1752	59.5	-6.5
6	.1795	58.4	-7.6
7	.1883	60.9	-5.1
8	.1975	57.8	-8.2
9	.2056	57.6	-8.4
10	.2281	63.9	-2.1



FREE FIELD TEST FACILITY
CONDUCTED EMISSIONS TEST RESULTS

19 Aug 1982 08:00:18

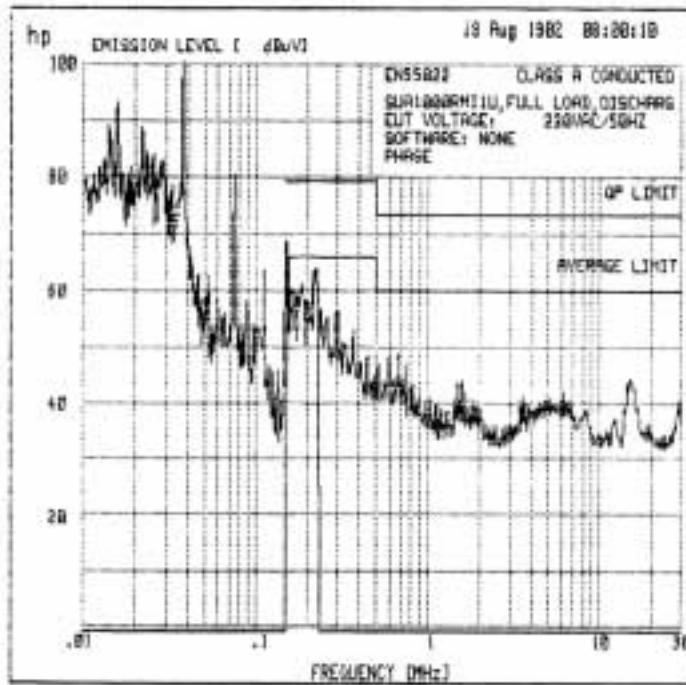
1. CONDUCTED
1.2 EN55022 CLASS A CONDUCTED

SUR1000RM11U, FULL LOAD, DISCHARG
EUT VOLTAGE: 230VAC/50HZ
SOFTWARE: NONE
PHASE

10 highest quasi-peaks above -30 dB of Limit Line #2
peak criteria = 1 dB

PEAK#	FREQ (MHz)	(dBμV)	DELTA
1	.1517	68.2	2.2
2	.167	57.1	-8.9
3	.1853	59.6	-6.4
4	.221	63.5	-2.5

$A_{V1} = 33.86 + 10 = 43.9$ (Limit = 66 dBμV Margin)



APPENDIX A

EMI Emissions and Immunity Test Form

The information contained in this Appendix was provided by Rick Everett 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: 07/18/02
Company: American Power Conversion **Contact:** Bryce Capodiecici, Rick Everett
Street: 85 Rangeway Road
City, State ZIP: North Billerica, MA 01821
Telephone: 978 - 670 - 2440 x 17275 **FAX:** 978-670-3747

Test Type:

Emissions			
CISPR 11	<input type="checkbox"/>		
CISPR 22	<input checked="" type="checkbox"/>	VDE	<input type="checkbox"/>
VCCI	<input type="checkbox"/>	Other _____	<input type="checkbox"/>
AUSTEL	<input type="checkbox"/>		
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 type="checkbox"/>
EN61000-4-4	<input checked="" type="checkbox"/>	EN61000-4-11	<input checked="" type="checkbox"/>
EN61000-4-5	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Special	<u>IEC 61000-2-2, EN 61000-3-2, EN 61000-3-3</u>	IEC60601-1-2	<input type="checkbox"/>
Add EN 61000-4-1 General Requirements to Certificate			
		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:

Uninterruptible Power Supply (UPS)

Model Number(s): SUA750RMI1U, SUA1000RMI1U **Serial Number(s):** N/A

EUT Weight(lb.): 39 lb. **EUT Size (LxWxH):** 25.75 x 17 x 1.76 inches

Power Interface:

Frequency 50/60 Hz
 Voltage 220 - 240Vac
 No. of Phases 1
 Current 10A
 Plug Type IEC
 Cord Type _____

Power Supply:

Description _____
 Manufacturer _____
 Model Number _____
 Switching Freq. _____
 RF Filter Manufac. _____
 RF Filter Model _____

Equipment Cycle Time: _____

Failure Criteria: _____

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):
 Main is 16 MHz, USB 24 MHz, Inverter 10-40 MHz,
 Battery Charger 30-70 MHz, See Attachment

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

Manufacturer	Part No.	Locations used

Cabinet Shielding/Construction of EUT:

N/A

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)
1		DB9	
1		USB	

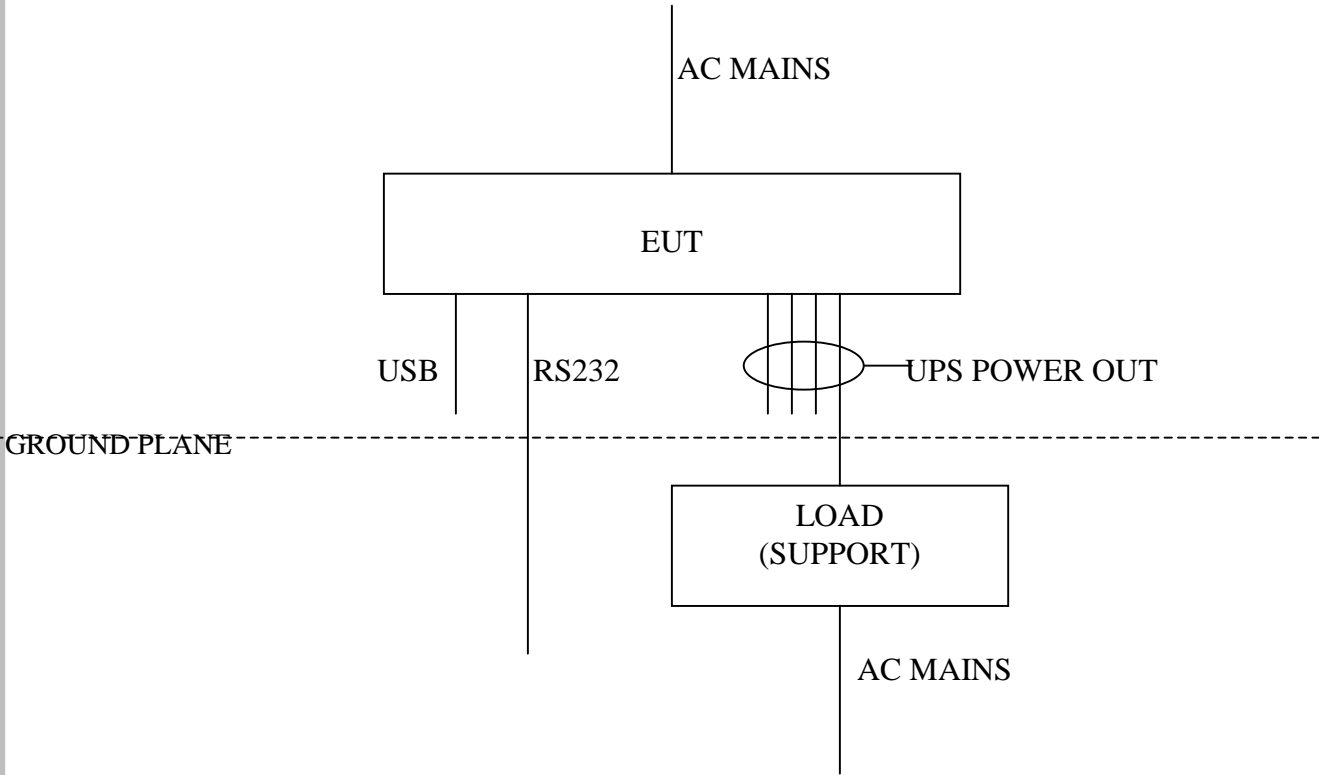
Software Description:

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.

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

Additional Information:

Block Diagram



APPENDIX B

QUEST CREDENTIALS

FCC registered test site

NVLAP Lab Code 200036-0

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

IEC/CISPR 22:1993, Amendment 1:1995, and Amendment 2:1996

CNS 13438:1997

Australian Standards referred to by clauses in ACA Technical Standards

AS/NZS 3548

Conformity Assessment Body (CAB) For the EMC annex

VCCI Registration Numbers R-712 and C732

Austel A96/TH/0079

AS/NZS 3584

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: Q02140

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
North Billerica, MA 01821, U.S.A.*

For

Product: Uninterruptible Power System

Model: SUA1000RMI1U and SUA750RMI1U

Date: August 19, 2002

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: Q02140. Quest Engineering Solutions acknowledges that the Equipment Under Test was found to have passed the following standards:

EN50091-2, Uninterruptable Power Systems (UPS)

**EN55022, 1994, Limits and Methods of Measurement of Radio
Disturbance Characteristics of Information Technology Equipment,
Class A**

Q02140

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