QUEST
ENGINEERING SOLUTIONS
7 Sterling Rd.
No. Billerica, MA 01862
Tel. 978-667-7000

TEST SERVICES

TEST REPORT #: Q02141

DATE: August 21, 2002

TITLE: Electromagnetic Immunity Tests of the Uninterruptible Power System

MODEL: SUA1000RMI1U and SUA750RMI1U
SERIAL NUMBER: N/A

STANDARDS:

EN50091-2, Uninterruptable Power Systems (UPS)

EN 61000-4-1

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
EN61000-4-11, Voltage Dips, Short Interruptions and Voltage Variations
EN61000-2-2, Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage supply systems

PREPARED FOR: Rick Everett
Company: American Power Conversion
Address: 85 Rangeway Road
North Billerica, MA 01821, U.S.A.

Telephone: 978-670-2440

PREPARED BY: Richard Ferris
Telephone: 978-667-7000 (X204)

REVIEWED BY: Frank Maglio, Jr.
Telephone: 978-667-7000 (X205)

NVLAP

TABLE OF CONTENTS

SECTION 1 OVERVIEW

1.1 Purpose of Test

To determine if the Uninterruptible Power System 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
ENV 50204, Radiated Electromagnetic Field From Digital Radio Telephones, 3 V/m, 900 ± 5 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.
EN61000-4-11, Voltage Dips, 30%/10ms, 60%/100ms, Short Interruptions >95%/5sec.
IEC 1000-2-2, Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage supply systems

1.2 Dates of Test

August 21, 2002

1.3 Summary of Test Results

Test	Result	Comments
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	
EN61000-4-11	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
° ENV 50204, 1996, Radiated Electromagnetic Field From Digital Radio Telephones
° 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
° EN61000-4-11, 1994, Voltage dips, short interruptions and voltage variations immunity tests
EN61000-2-2, 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 a Uninterruptible Power System. The voltage supplied to the EUT was 230 VAC, 60 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

3.3 Laboratory Test Configuration

Test Equipment:

MANUF.	EQUIPMENT	MODEL	SERIAL #	CAL. FREQ.	DUE
GENERAL TEST EQUIPMENT:					
HP	SPECTRUM ANALYZER	8568B	2634A02760	12 MONTHS	1/03
HP	FUNCTION GENERATOR	3312A	1432A13018	NO CAL NEEDED	
TANDY	THERMO & HYGRO.	63-855		12 MONTHS	04/03
SINGER	MONITOR CLAMP	CP-105	NONE	12 MONTHS	09/02

MANUF.	EQUIPMENT	MODEL	SERIAL #	CAL. FREQ.	DUE
RADIATED	**TEST EQUIPMENT:**				
PANASHIELD	FERRITE CHAMBER	N/A	EMI#1	12 MONTHS	09/02
KALMUS	RF AMPLIFIER	757LCB-CE	7762-1	NO CAL NEEDED	
WANDEL & GOLTERMANN	FIELD SENSOR	EMR-200	2240/21	24 MONTHS	10/02
WANDEL & GOLTERMANN	PROBE	Type 8	0099	24 MONTHS	10/02
HP	POWER METER	436A	1803A03376	NO CAL NEEDED	
HP	POWER SENSOR	8482A	US37292933	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	09/02
FISCHER	CDN	FCC-801-M2-32	101	12 MONTHS	09/02
FISCHER	CDN	FCC-801-M1-25	29	12 MONTHS	09/02
FISCHER	INJECTION PROBE	F-120-9B	22	12 MONTHS	09/02
BIRD	50 OHM LOAD	8166	4397	NO CAL NEEDED	
WEINSCHEL	10DB ATTENUATOR,50W	24-10-43	AG6340	NO CAL NEEDED	
WEINSCHEL	20DB ATTENUATOR,50W	40-20-43	GP368	12 MONTHS	10/02

EFT/SURGE	TEST EQUIPMENT:				
KEYTEK	ECAT SYSTEM WITH EFT/B SOURCE SURGE NETWORK COUPLER/DECOUPLER	E103 E411 E501 E4554	9309426	12 MONTHS	11/02
KEYTEK	COUPLING CLAMP	CCL - 4/S	9309209	NO CAL NEEDED	
TEKTRONIX	FUNCTION GENERATOR	TM503	B127178	NO CAL NEEDED	
TEKTRONIX	OSCILLOSCOPE	7104	B021171	NO CAL NEEDED	
TEKTRONIX	OSCILLOSCOPE	7603	B378014	12 MONTHS	05/03

ESD	TEST EQUIPMENT:				
SCHAFFNER	ESD SIMULATOR	NSG-432	00193	12 MONTHS	09/02
SCHAFFNER	ADAPTER HEAD	402-568	193-B	12 MONTHS	09/02
SCHAFFNER	ADAPTER HEAD	402-580	193-C	12 MONTHS	09/02

SCHAFFNER	ADAPTER HEAD	402-628	9237	12 MONTHS	09/02
SCHAFFNER	ADAPTER HEAD	402-645	9244	12 MONTHS	09/02
SCHAFFNER	REAL ESD ADAPT.	SL402-619	116	12 MONTHS	09/02

VOLTAGE DIPS, INTERRUPTIONS & VARIATION TEST	**EQUIPMENT**				
BEHLMAN	POWER SOURCE	ACP-3000-100	3209	NO CAL NEEDED	
TEKTRONIX	OSCILLOSCOPE	7603	B378014	12 MONTHS	05/03
TEKTRONIX	PROGRAMMABLE DIGITIZER	7D20	B063600	12 MONTHS	05/03

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.= 71°F, Relative Humidity = 46%

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 on Mains

3.4 Pictures (continued)

EUT Setup for EN61000-4-4 on Data Cables

EUT Setup for EN61000-4-5 on Mains

3.4 Pictures (continued)

EUT Setup for EN61000-4-6 on Mains

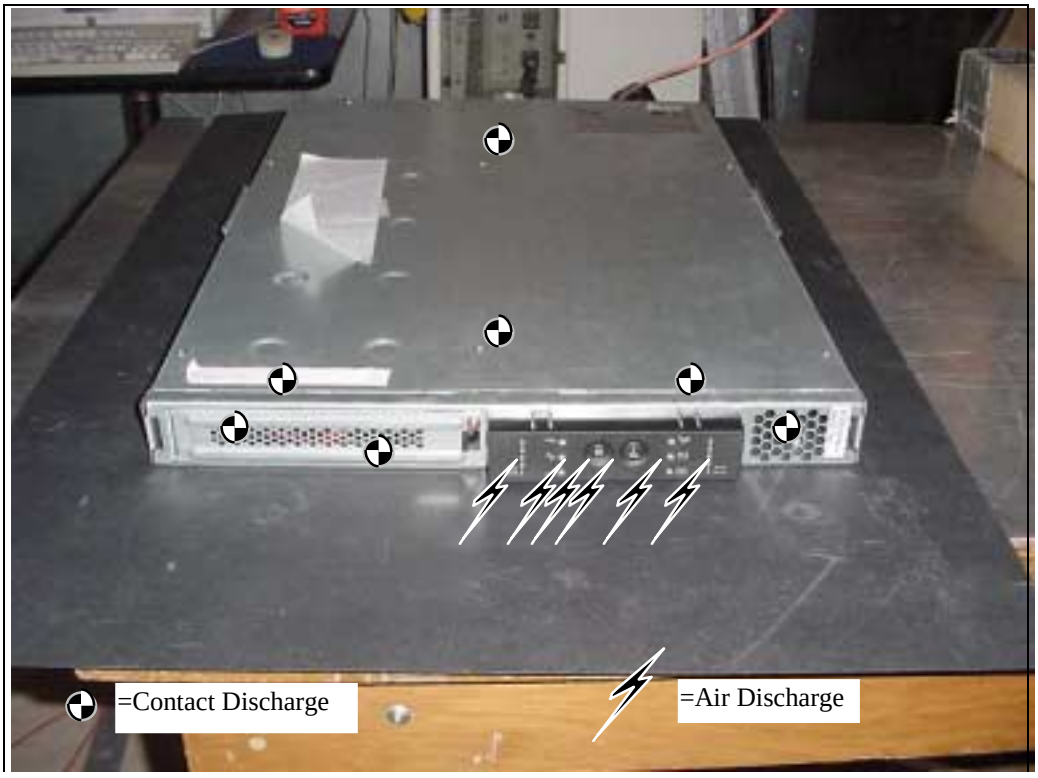
EUT Setup for EN61000-4-6 on Data Cables

3.4 Pictures (continued)

EUT Setup for EN61000-4-11

EUT Setup for IEC 1000-2-2

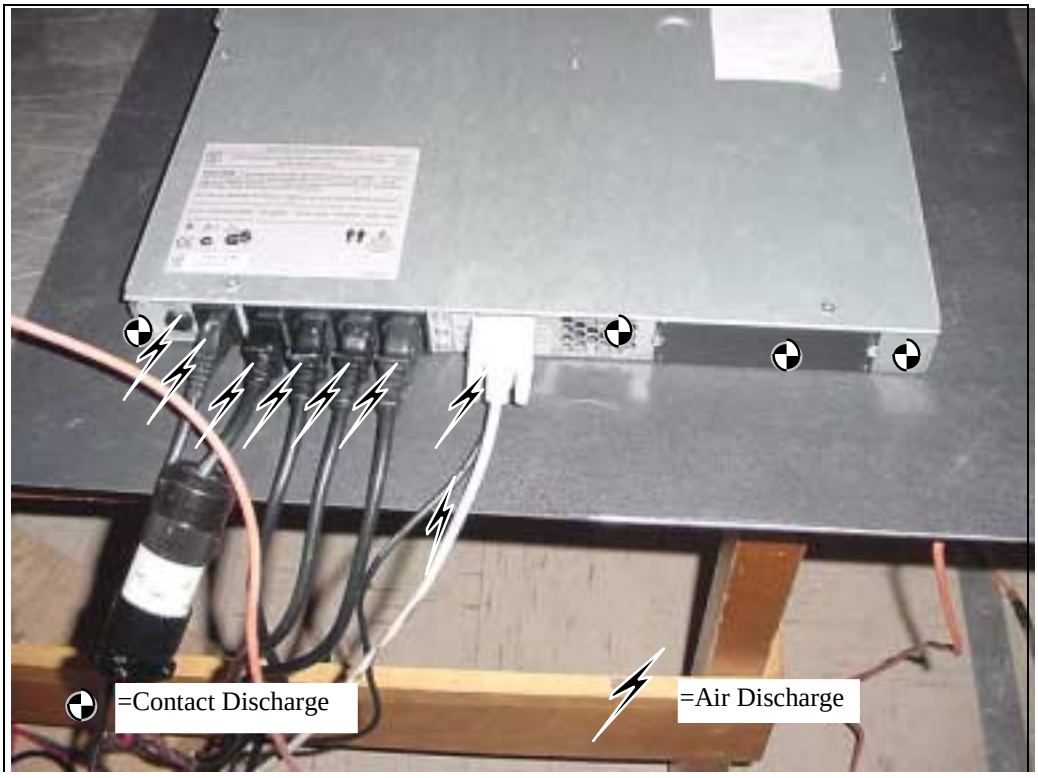
3.4 Pictures (continued)



ESD Discharge Points

ESD Discharge Points

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

TEST	LEVEL	RESULTS	COMMENTS
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: *Reference EN50091-2, 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 #1

TEST	LEVEL	RESULTS	COMMENTS
26 to 1000 MHz at (80% AM @ 1 kHz)	3 V/M	PASSED	
900 ±5 MHz (95% PM @ 200 Hz)	3 V/M	PASSED	*(per ENV 50204)*

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 dwels were made to the 10^{th} 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

TEST	LINE	RESULTS	COMMENTS
FAST TRANSIENTS/BURST TEST ON MAINS			
± 1 kV pulses, 5 nsec rise/50 nsec duration 5.0 kHz pulse repetition rate 15 msec ± 20% burst length 300 msec ± 20% burst period Applied for 1 minutes per polarity	Phase Neutral Ground	PASSED PASSED PASSED	CRITERIA A CRITERIA A CRITERIA A
FAST TRANSIENTS/BURST TEST ON DATA CABLES			
± 0.5kV pulses, 5 nsec rise/50 nsec duration 5.0 kHz pulse repetition rate 15 msec ± 20% burst length 300 msec ± 20% burst period. Applied for 1 minutes per polarity	All copper I/O cables, refer to Test Form for details.	PASSED	CRITERIA A

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

EN61000-4-5, SURGE IMMUNITY

Open circuit voltage: 1.2/50μs 6kV Maximum
Short circuit current: 8/20μs 3kA Maximum
The EUT is a single phase unit.
EUT Voltage = 230 VAC/50 Hz

Test facility used: EMI #2

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

Note: Phase to Neutral test not performed at customer request

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

EN61000-4-6, CONDUCTED DISTURBANCES BY RF FIELDS

Test facility used: EMI #1

CONDUCTED DISTURBANCES ON MAINS

TEST	LEVEL	LINE	RESULTS	COMMENTS
0.150 to 80 MHz	1kV	Phase, Neutral, Ground	PASSED	

(80% AM @ 1 kHz)

CONDUCTED DISTURBANCES ON DATA CABLES

TEST	LEVEL	LINE	RESULTS	COMMENTS
0.150 to 80 MHz (80% AM @ 1 kHz)	0.5kV	All copper I/O, refer to Test Form for details.	PASSED	

Performance Criterion A of EN50091-2 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 was less than 1.5 x* 10^{-3} *decades/sec.*

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

Test facility used: Safety Lab.

Voltage Dips

TEST	RESULTS	COMMENTS
30% for 10 ms	Passed	
60% for 100 ms	Passed	

Voltage Interruptions

TEST	RESULTS	COMENTS
95% for 5000 ms	Passed	CRITERIA A

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

IEC 1000-2-2, Low Frequency Disturbances

Test facility used: EMI #2

TEST	RESULTS	COMMENTS
10V RMS from 140Hz to 360Hz	Passed	CRITERIA A

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

4.2 Special Notes

The test engineer was F. Maglio, B. Melanson and R. Ferris.

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 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 Capodieci, 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	☐		
CISPR 22	☒	VDE	☐
VCCI	☐	Other	☐
AUSTEL	☐		
Class A (1)	☒		
Class B (2)	☐		

Immunity

EN50082-1	☐	EN50082-2	☐	IEC60601-1-2	☐
EN61326	☐	EN61000-6-2	☐		
EN61000-4-2	☒	EN61000-4-6	☒	Test Level 1	☐
EN61000-4-3	☒	EN61000-4-8	☐	Test Level 2	☐
EN61000-4-4	☒	EN61000-4-11	☒	Test Level 3	☐
EN61000-4-5	☒			Test Level 4	☐

Special IEC 61000-2-2, EN 61000-3-2, EN 61000-3-3
Add EN 61000-4-1 General Requirements to Certificate

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, gasketting, 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.

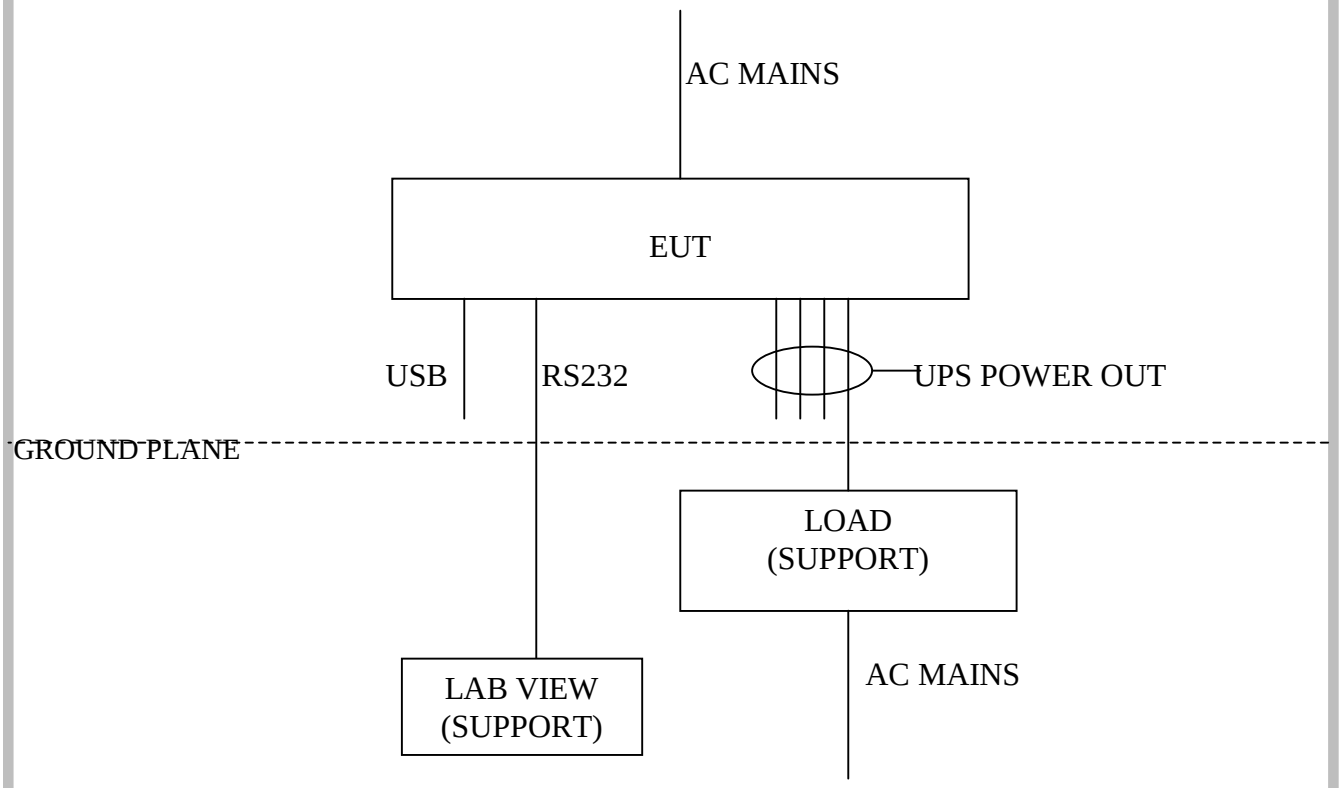
Internal Firmware

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

AC Load, 10 kW Avtron

Additional Information:

Block Diagram



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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: Q02141

	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

QUEST
ENGINEERING SOLUTIONS

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 21, 2002

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: Q02141. 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)

EN 61000-4-1

EN61000-4-2, Electrostatic Discharge
EN61000-4-3, Radiated Electromagnetic Fields
ENV50204, Radiated Electromagnetic Field From Digital Radio Telephones
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