





Curtis-Straus LLC, a wholly owned subsidiary of BV CPS

# Test Report

Report No	EK1310-1, Issue 3
Client	APC Corporation David Wu
Address	85 Rangeway Road Billerica, MA 01862
Phone	978-670-2440
Items tested Also Compliant	SMX3000RMHV2UNC SMX3000RMHV2U and SMX2200RMHV2U
Standards	EN 55022:2006/A1:2007, ICES-003 Issue 4, 47 CFR FCC Part 15, VCCI, AS/NZS CISPR 22:2006, EN 61000-3-2:2006, EN 61000-3-3:1995/A1:2001/A2:2005, EN 62040-2:2006, EN 55024:1998/A1:2001/A2:2003
Test Dates	October 4, 5, 6, 7, 8, 11, 12, November 4, 5, and 8, 2010 and February 14-18, 2011
Results	As detailed within this report
Prepared by	 Disha Vachhani – Test Engineer
Authorized by	 John Underwood – EMC Manager
Issue Date	<u>3/17/2011</u>
Conditions of Issue	This Test Report is issued subject to the conditions stated in the 'Conditions of Testing' section on page 102 of this report.

Curtis-Straus LLC is accredited by the American Association for Laboratory Accreditation for the specific scope of accreditation under Certificate Number 1627-01. This report may contain data which is not covered by the A2LA accreditation.



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## Contents

Contents .....	2
Summary .....	3
Product Tested .....	5
Configuration Documentation .....	5
Clock Frequencies .....	5
Block Diagram .....	6
Performance Criteria .....	6
Compliance Statement .....	7
Modifications Required for Compliance .....	8
RADIATED EMISSIONS .....	9
CONDUCTED EMISSIONS .....	18
TELCO CONDUCTED EMISSIONS .....	25
EN55022 Telco Cable Conducted Current Emissions Testing Overview .....	29
ELECTROSTATIC DISCHARGE IMMUNITY .....	31
Electrostatic Discharge Testing Overview .....	42
RADIATED RADIO-FREQUENCY IMMUNITY .....	44
ELECTRICAL FAST TRANSIENTS IMMUNITY .....	49
SURGE IMMUNITY .....	54
CONDUCTED RADIO FREQUENCY IMMUNITY .....	61
MAGNETIC FIELD IMMUNITY .....	66
Power Frequency Magnetic Field Immunity Testing Overview .....	69
VOLTAGE DIPS AND INTERRUPTS IMMUNITY .....	70
HARMONIC EMISSIONS AND VOLTAGE FLUCTUATIONS/FLICKER .....	75
Meeting Voltage Fluctuation Requirements .....	86
LOW FREQUENCY CONDUCTED DISTURBANCE IMMUNITY .....	88
Measurement Uncertainty .....	92
Product Documentation .....	93
Jurisdictional Labeling and Required Instruction Manual Inserts .....	94
CE Marking - European Union (EU) .....	94
Sample Declaration of Conformity .....	94
EN 55022 Class A Warning Requirements .....	95
FCC Requirements .....	95
FCC Part 18 Required Labeling for Industrial, Scientific and Medical Equipment .....	97
Australian Communications and Media Authority (ACMA) .....	98
Canadian Requirements .....	100
VCCI Requirements .....	100
Conditions Of Testing .....	102

REV 11-MAR-10 (SC)



## Summary

On October 4, 5, 6, 7, 8, 11, 12, November 4, 5, and 8, 2010 and February 14-18, 2011 we tested the SMX3000RMHV2UNC for compliance with the following requirements:

### EMC Emissions:

- EN 55022:2006/A1:2007 Class A ITE emissions requirements (EU)
- ICES-003 Issue 4 Class A Digital Apparatus emissions requirements (Canada)
- 47 CFR FCC Part 15 Class A emissions requirements (USA)
- VCCI Class A ITE emissions requirements (Japan)
- AS/NZS CISPR 22: 2006 Class A ITE emissions requirements (Australia)
- EN 61000-3-2:2006 Limits for harmonic current emissions (equipment input current up to and including 16A per phase)
- EN 61000-3-3:1995/A1:2001/A2:2005 Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current up to and including 16 A

### EMC Immunity:

- EN 55024:1998/A1:2001/A2:2003 ITE - immunity characteristics

### EMC Emissions and Immunity:

- EN 62040-2:2006 - Electromagnetic compatibility (EMC) requirements for uninterruptible power systems UPS of category C3

We found that the product met the above requirements with modification (see *Modifications Required for Compliance* section on page 7). The test sample was received in good condition. The sample was received on October 4, 2010.

Issue No.	Reason for change	Date Issued
1	Original Release	January 6, 2011
2	Corrected model number for SMX2200RMHV2U Corrected differences statement	February 4, 2011
3	Added data for EN62040-2	March 18, 2011

page 3 of 103
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Testing was performed with the EUT operating in three different modes. See the table below for specific testing performed.

Test	AVR Mode	Green Mode	On Battery	Comment
Radiated Emissions	Tested	Tested	Tested	
AC Conducted Emissions	Tested	Tested	Tested	
Telco Conducted Emissions	Tested	Tested	Tested	
ESD Immunity	Tested	Not Tested	Not Tested	
Radiated RF Immunity	Tested	Not Tested	Not Tested	
EFT Immunity	Tested	Tested	Not Tested	AC input only
AC Input Surge Immunity	Tested	Tested	Not Tested	
AC Output Surge Immunity	Tested	Tested	Not Tested	
Signal Surge Immunity	Tested	Not Tested	Not Tested	
Conducted RF Immunity	Tested	Tested	Not Tested	AC input only
Magnetic Field Immunity	Tested	Tested	Not Tested	
Voltage Dips and Interrupts	Tested	Tested	Not Tested	
Harmonics	Tested	Tested	Not Tested	
Flicker	Tested	Tested	Not Tested	
Immunity to Low Frequency Signals	Tested	Tested	Not Tested	

Please note that the SMX3000RMHV2UNC is a representative of the SMX3000RMHV2U and SMX2200RMHV2U. All three models are physically identical. The SMX2200RMHV2U model has a lower VA/power rating than the unit tested. Lastly, the SMX3000RMHV2UNC has network installed, while it is only an option for the other models.

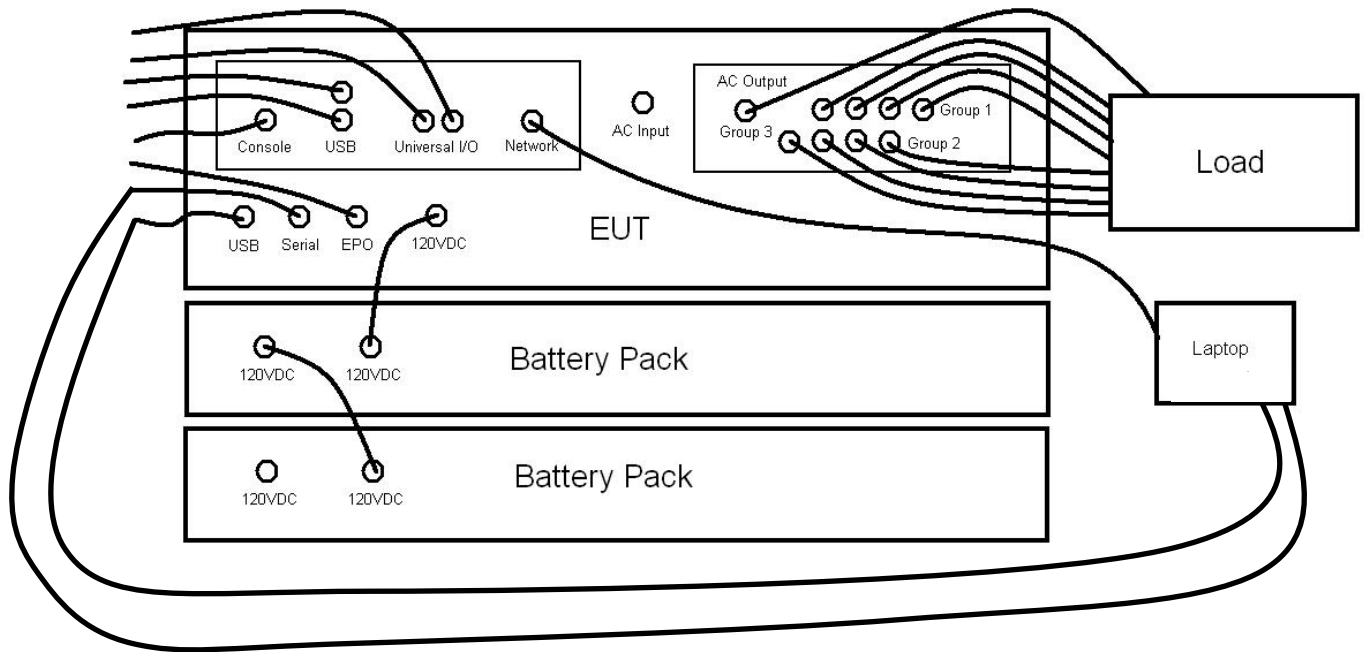
**Product Tested****Configuration Documentation**

EUT Configuration										
Work Order: K1310 Company: APC Corporation Company Address: 85 Rangeway Road North Billerica, MA 01862 Contact: David Wu										
MN			PN					SN		
EUT:			SMX3000RMHV2UNC					Sample 1		
Battery Pack			SMX120RMBP2U					RBC117		
Battery Pack			SMX120RMBP2U					RBC118		
EUT Description: Colt HV is a UPS with battery backups										
EUT Max Frequency: 200MHz										
EUT Min Frequency: 0.024MHz										
Support Equipment:			MN					SN		
Battery Extention Cable			SMX039					Sample 1		
Avtron resistive load			K490					452		
Dell Laptop			D630					---		
EUT Ports:										
Port Label	Port Type	No. of ports	No. Populated	Cable Type	Shielded	Ferrites	Length	Max Length	In/Out NEBS Type	Unpopulated Reason
AC Input	Power AC	1	1	3-wire AC	No	No	2m	2m	in	
Serial Port	RS-232	1	1	RJ45	No	No	2m	20m	in	
USB	USB	1	1	USB	Yes	No	2m	5m	in	
EPO	Signal	1	1	Signal	No	No	2m	2m	in	
120VDC	Power DC	1	1	2-wire DC	No	2 each end	2m	2m	in	
Group 1	Power AC	1	1	3-wire AC	No	No	1m	2m	in	
Group 2	Power AC	4	4	3-wire AC	No	No	2m	2m	in	
Group 3	Power AC	4	4	3-wire AC	No	No	2m	2m	in	
Console	Console	1	1	Coaxial	No	No	2m	2m	in	
USB 2	USB	2	2	USB	Yes	No	2m	5	in	
Universal I/O	other	2	1	RJ45	No	No	2m	2m	in	Redundant
Network (10/100)	Ethernet	1	1	RJ45	No	No	2m	100m	in	
Software / Operating Mode Description:										
UPS with inverter supplying load. USB, Serial, and Ethernet communications with support laptop must continue successfully.										

**Clock Frequencies**

EUT Frequencies (MHz)
0.024
0.066
0.1
8
20
25
48
100
200

## Block Diagram



## Performance Criteria

**Criterion A:** The unit must operate as intended during the test. In particular, the EUT shall continue to supply power to the load. The EUT shall continue to communicate with the support laptop which is displaying various system statistics.

**Criterion B:** The unit must operate as intended at the conclusion of the test with no loss of state or data.

**Criterion C:** Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions.

**Compliance Statement**

TEST	RESULT	STANDARD	TEST LEVEL	MARGIN	COMMENTS
<b>Radiated Emissions</b>	PASS	EN55022:2006/ A1:2007/ ICES-003 Issue 4 / 47 CFR FCC Part 15 / VCCI / AS/NZS CISPR 22: 2006/ EN 62040-2:2006	Class A	-6.8 dB @ 32.0 MHz	
<b>AC Mains Conducted Emissions</b>	PASS	EN55022:2006/ A1:2007/ ICES-003 Issue 4 / 47 CFR FCC Part 15 / VCCI / AS/NZS CISPR 22: 2006/ EN 62040-2:2006	Class A	-4.6 dB @ 0.17 MHz	
<b>AC Output Conducted Emissions</b>	N/A	EN 62040-2:2006	N/A	N/A	AC output cables are less than 10m
<b>Telco Line Conducted Emissions</b>	PASS	EN55022:2006/A1:2007 / VCCI / EN 62040-2:2006	Class A	-12.90 dB @ 16.23 MHz	
<b>ESD</b>	PASS	EN 61000-4-2	±8kV contact, ±10kV air	N/A	Performance Criteria B
<b>RFI - Amplitude Modulated</b>	PASS	EN 61000-4-3	27 -6000 MHz 10 V/m 80% AM (1 kHz)	N/A	Performance Criteria A
<b>EFT</b>	PASS	EN61000-4-4	±4kV AC mains, ±2kV other	N/A	Performance Criteria B
<b>AC Input Surge</b>	PASS	EN 61000-4-5	±2kV Common ±1kV Differential	N/A	Performance Criteria B
<b>AC Output Surge</b>	PASS	EN 61000-4-5	±2kV Common ±1kV Differential	N/A	Performance Criteria B
<b>DC Surge</b>	N/A	EN 61000-4-5	N/A	N/A	EUT is AC powered

TEST	RESULT	STANDARD	TEST LEVEL	MARGIN	COMMENTS
<b>Telco Surge</b>	PASS	EN 61000-4-5	±1kV	N/A	Performance Criteria B
<b>CRFI</b>	PASS	EN 61000-4-6	10V, 0.15-0MHz, 1kHz 80% AM	N/A	Performance Criteria A
<b>Power-Frequency Magnetic Field</b>	PASS	EN 61000-4-8	30 A/m	N/A	Performance Criteria A
<b>Voltage Dips And Short Interruptions</b>	PASS	EN 61000-4-11	<5%V for 0.5 and 1 cycle	N/A	Performance Criteria B
			70%V for 30 cycles		Performance Criteria C
	PASS	EN 61000-4-11	<5%V for 300 cycles	N/A	Performance Criteria C
<b>Harmonics</b>	PASS	EN 61000-3-2	Class A		
<b>Flicker</b>	PASS	EN 61000-3-3			
<b>Immunity to Low Frequency Signals</b>	PASS	EN 61000-2-2	10V	N/A	Performance Criteria A
<b>Voltage Unbalance</b>	N/A	EN 61000-2-2	N/A	N/A	EUT is not 3 phase equipment

### Modifications Required for Compliance

In order to be compliant with Harmonics, firmware was updated to fix zero-crossing detection. Prior to the modification, the EUT would fail with a full load and no load.



**RADIATED EMISSIONS****Test Method:**

In accordance with the following:

- EN55022:2006/ A1:2007
- ICES-003 Issue 4
- 47 CFR FCC Part 15
- VCCI
- AS/NZS CISPR22:2006
- EN 62040-2:2006

**Results:**

TEST	RESULT	TEST LEVEL	MARGIN	COMMENTS
<b><i>Radiated Emissions</i></b>	PASS	Class A	-6.8 dB @ 32.0 MHz	

## Radiated Emissions Data Table(s):

Table 1

Radiated Emissions Table												
Date: 04-Oct-10			Company: APC			Work Order: K1310						
Engineer: Andrew Chin			EUT Desc: Colt HV			EUT Operating Voltage/Frequency: 220V/60Hz						
Temp: 26.7°C			Humidity: 30%			Pressure: 1018mBar						
Frequency Range: 30-1000MHz						Measurement Distance: 3 m						
Notes: AVR Full Load						EUT Max Freq: 200MHz						
Antenna Polarization (H/V)	Frequency (MHz)	Reading (dBuV)	Preamp Factor (dB)	Antenna Factor (dBm)	Cable Factor (dB)	Adjusted Reading (dBuV/m)	CISPR Class A			FCC Class A		
							Limit (dBuV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBuV/m)	Margin (dB)	Result (Pass/Fail)
v	32.0	44.1	22.6	20.8	0.4	42.7	50.5	-7.8	Pass	49.5	-6.8	Pass
v	39.852	44.2	22.6	14.9	0.5	37.0	50.5	-13.5	Pass	49.5	-12.5	Pass
v	50.6275	44.7	22.6	8.6	0.5	31.2	50.5	-19.3	Pass	49.5	-18.3	Pass
v	67.1	43.8	22.6	8.4	0.5	30.1	50.5	-20.5	Pass	49.5	-19.5	Pass
v	125.0	45.8	22.6	14.4	0.7	38.3	50.5	-12.2	Pass	54.0	-15.7	Pass
v	201.0	49.1	22.6	13.0	0.9	40.4	50.5	-10.1	Pass	54.0	-13.6	Pass
v	225.0	47.2	22.6	11.6	1.0	37.2	50.5	-13.3	Pass	56.9	-19.7	Pass
v	250.0	54.6	22.6	12.3	0.9	45.2	57.5	-12.3	Pass	56.9	-11.7	Pass
v	300.0	46.7	22.6	14.0	1.0	39.1	57.5	-18.4	Pass	56.9	-17.8	Pass
v	325.0	46.1	22.5	14.6	0.9	39.1	57.5	-18.4	Pass	56.9	-17.8	Pass
h	375.0	44.0	22.7	15.7	0.9	37.9	57.5	-19.6	Pass	56.9	-19.0	Pass
Table Result: Pass						by	-6.8 dB			Worst Freq: 32.0 MHz		
Test Site: EMI Chamber 2			Cable 1: Asset #1506			Cable 2: Asset #1508			Cable 3: ---			
Analyzer: Asset #1328			Preamp: Blue			Antenna: Red-White			Preselector: ---			

Table 2

Radiated Emissions Table												
Date: 04-Oct-10			Company: APC				Work Order: K1310					
Engineer: Andrew Chin			EUT Desc: Colt HV				EUT Operating Voltage/Frequency: Battery					
Temp: 26.7°C			Humidity: 30%				Pressure: 1018mBar					
Frequency Range: 30-1000MHz							Measurement Distance: 3 m					
Notes: Battery Full Load							EUT Max Freq: 200MHz					
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	CISPR Class A			FCC Class A		
							Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
v	30.2	39.2	22.6	22.2	0.4	39.2	50.5	-11.3	Pass	49.5	-10.3	Pass
v	50.0	43.1	22.6	8.9	0.5	29.9	50.5	-20.6	Pass	49.5	-19.6	Pass
v	125.0	45.7	22.6	14.4	0.7	38.2	50.5	-12.3	Pass	54.0	-15.8	Pass
v	200.0	47.4	22.6	13.3	0.9	39.0	50.5	-11.5	Pass	54.0	-15.0	Pass
v	225.0	47.8	22.6	11.6	1.0	37.8	50.5	-12.7	Pass	56.9	-19.1	Pass
h	250.0	54.8	22.6	12.3	0.9	45.4	57.5	-12.1	Pass	56.9	-11.5	Pass
v	275.0	46.5	22.6	13.7	1.0	38.6	57.5	-18.9	Pass	56.9	-18.3	Pass
v	300.0	48.7	22.6	14.0	1.0	41.1	57.5	-16.4	Pass	56.9	-15.8	Pass
h	325.0	45.4	22.5	14.6	0.9	38.4	57.5	-19.1	Pass	56.9	-18.5	Pass
h	375.0	44.2	22.7	15.7	0.9	38.1	57.5	-19.4	Pass	56.9	-18.8	Pass
Table Result: Pass							by		-10.3 dB		Worst Freq: 30.2 MHz	
Test Site: EMI Chamber 2			Cable 1: Asset #1506			Cable 2: Asset #1508			Cable 3: ---			
Analyzer: Asset #1328			Preamp: Blue			Antenna: Red-White			Preselector: ---			

Table 3

Radiated Emissions Table												
Date: 04-Oct-10			Company: APC			Work Order: K1310						
Engineer: Andrew Chin			EUT Desc: Colt HV			EUT Operating Voltage/Frequency: 220V/60Hz						
Temp: 26.7°C			Humidity: 30%			Pressure: 1018mBar						
Frequency Range: 30-1000MHz						Measurement Distance: 3 m						
Notes: Green Full Load						EUT Max Freq: 200MHz						
Antenna Polarization (H/V)	Frequency (MHz)	Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBμV/m)	CISPR Class A			FCC Class A		
							Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)
v	61.5	45.2	22.6	7.8	0.5	30.9	50.5	-19.6	Pass	49.5	-18.6	Pass
v	125.0	45.7	22.6	14.4	0.7	38.2	50.5	-12.3	Pass	54.0	-15.8	Pass
v	200.0	48.4	22.6	13.3	0.9	40.0	50.5	-10.5	Pass	54.0	-14.0	Pass
v	225.0	48.6	22.6	11.6	1.0	38.6	50.5	-11.9	Pass	56.9	-18.3	Pass
h	250.0	54.5	22.6	12.3	0.9	45.1	57.5	-12.4	Pass	56.9	-11.8	Pass
v	275.0	46.0	22.6	13.7	1.0	38.1	57.5	-19.4	Pass	56.9	-18.8	Pass
v	300.0	48.4	22.6	14.0	1.0	40.8	57.5	-16.7	Pass	56.9	-16.1	Pass
h	325.0	46.2	22.5	14.6	0.9	39.2	57.5	-18.3	Pass	56.9	-17.7	Pass
h	375.0	44.4	22.7	15.7	0.9	38.3	57.5	-19.2	Pass	56.9	-18.6	Pass
Table Result: Pass						by	-10.5 dB			Worst Freq: 200.0 MHz		
Test Site: EMI Chamber 2			Cable 1: Asset #1506			Cable 2: Asset #1508			Cable 3: ---			
Analyzer: Asset #1328			Preamp: Blue			Antenna: Red-White			Preselector: ---			

Table 4

Radiated Emissions Table														
Date: 04-Oct-10			Company: APC			Work Order: K1310								
Engineer: Andrew Chin			EUT Desc: Colt HV			EUT Operating Voltage/Frequency: 230V/50Hz								
Temp: 26.7°C			Humidity: 30%			Pressure: 1018mBar								
Frequency Range: 1000-2000MHz										Measurement Distance: 3 m				
Notes: AVR Full Load										EUT Max Freq: 200MHz				
Antenna Polarization (H/V)	Frequency (MHz)	Peak Reading (dBμV)	Average Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBμV/m)	Adjusted Avg Reading (dBμV/m)	CISPR Class A High Frequency - Peak			CISPR Class A High Frequency - Average		
									Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)
No Emissions found in this range														
Table Result: --- by --- dB Worst Freq: --- MHz														
Test Site: EMI Chamber 2			Cable 1: Asset #1506			Cable 2: Asset #1508			Cable 3: ---					
Analyzer: Asset #1328			Preamp: Red-Blue			Antenna: Orange Horn			Preselector: ---					

Table 5

Radiated Emissions Table														
Date: 04-Oct-10			Company: APC				Work Order: K1310							
Engineer: Andrew Chin			EUT Desc: Colt HV				EUT Operating Voltage/Frequency: Battery							
Temp: 26.7°C			Humidity: 30%				Pressure: 1018mBar							
Frequency Range: 1000-2000MHz										Measurement Distance: 3 m				
Notes: Battery Full Load										EUT Max Freq: 200MHz				
Antenna Polarization (H/V)	Frequency (MHz)	Peak Reading (dBμV)	Average Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBμV/m)	Adjusted Avg Reading (dBμV/m)	CISPR Class A High Frequency - Peak			CISPR Class A High Frequency - Average		
									Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)
									---	---	---	---	---	---
No Emissions found in this range.														
Table Result: --- by --- dB Worst Freq: --- MHz														
Test Site: EMI Chamber 2			Cable 1: Asset #1506				Cable 2: Asset #1508				Cable 3: ---			
Analyzer: Asset #1328			Preamp: Red-Blue				Antenna: Orange Horn				Preselector: ---			

Table 6

Radiated Emissions Table														
Date: 04-Oct-10			Company: APC			Work Order: K1310								
Engineer: Andrew Chin			EUT Desc: Colt HV			EUT Operating Voltage/Frequency: 220V/60Hz								
Temp: 26.7°C			Humidity: 30%			Pressure: 1018mBar								
Frequency Range: 1000-2000MHz										Measurement Distance: 3 m				
Notes: Green Full Load										EUT Max Freq: 200MHz				
Antenna Polarization (H/V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	CISPR Class A High Frequency - Peak			CISPR Class A High Frequency - Average		
									Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
No Emissions found in this range.														
Table Result: --- by --- dB Worst Freq: --- MHz														
Test Site: EMI Chamber 2			Cable 1: Asset #1506			Cable 2: Asset #1508			Cable 3: ---					
Analyzer: Asset #1328			Preamp: Red-Blue			Antenna: Orange Horn			Preselector: ---					

Rev: 23-Sep-2010

<b>Spectrum Analyzers / Receivers /Preselectors</b>		<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
SA EMI Chamber (1328)		9kHz-13.2 GHz	E4405B	Agilent	MY44210241	1328	I	16-Dec-2010
<b>Radiated Emissions Sites</b>		<b>FCC Code</b>	<b>IC Code</b>	<b>VCCI Code</b>			<b>Cat</b>	<b>Calibration Due</b>
EMI Chamber 2		719150	2762A-7	R-3033, G-107			I	15-Feb-2011
<b>Preamps /Couplers Attenuators / Filters</b>		<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Blue		0.009-2000MHz	ZFL-1000-LN	CS	N/A	759	II	6-Apr-2011
Red-Blue		1-18GHz	PE2-38-218-4R5-17-15-SFF	CS	NA	1257	II	15-Jun-2011
<b>Antennas</b>		<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Red-White Bilog		30-2000MHz	JB1	Sunol	A091604-1	1105	I	17-Dec-2010
Orange Horn		1-18GHz	3115	EMCO	0004-6123	390	I	19-Jun-2011
<b>Meteorological Meters</b>			<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Weather Clock (Pressure Only)			BA928	Oregon Scientific	C3166-1	831	I	17-Mar-2011
CHAMBER2 Thermohygrometer			35519-044	Control Company	72457639	1347	II	18-Aug-2011
<b>Cables</b>		<b>Range</b>		<b>Mfr</b>			<b>Cat</b>	<b>Calibration Due</b>
Asset #1506		9kHz - 18GHz		Florida RF			II	16-Aug-2011
Asset #1508		9kHz - 26.5GHz		Florida RF			II	20-Apr-2011

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

## Radiated Emissions Modifications:

None



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 One Distribution Center Circle, #1 • Littleton, MA • TEL (978) 486-8880 • FAX (978) 486-8828

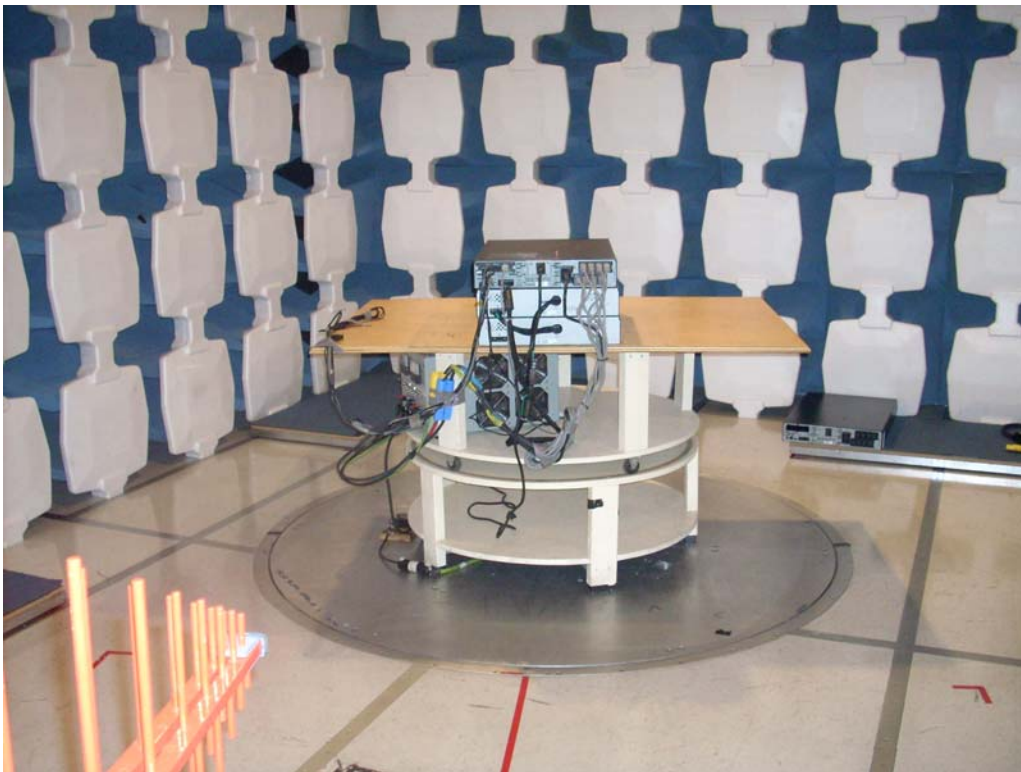


page 11 of  
103

**Radiated Emissions Setup Photograph(s):**



**30-1000MHz (Front)**

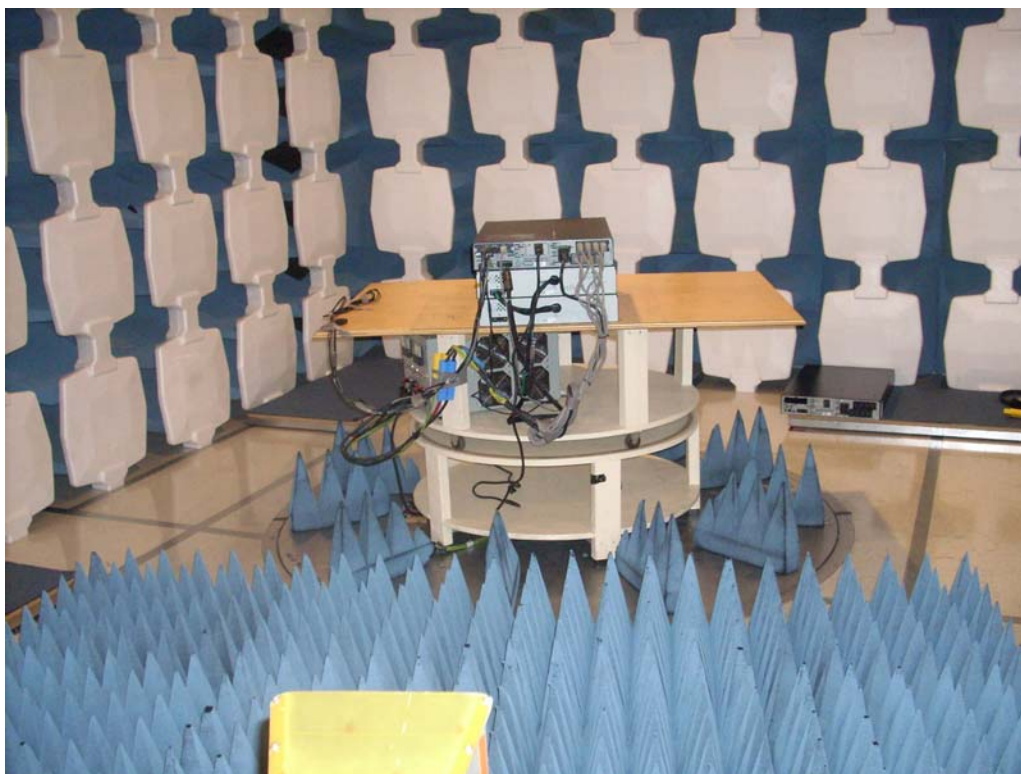


**30-1000MHz (Rear)**





1-2GHz (Front)



1-2GHz (Rear)

## Radiated Emissions Testing Overview

REV 10-APR-09

Digital and microprocessor based devices use radio frequency (RF) digital signals for timing purposes. An unintentional consequence of this signal usage is that a certain amount of RF energy is radiated from the device into the local environment. This radiated RF energy has the potential to interfere with constructive uses of the RF spectrum such as television broadcasting, police and fire radio, and the like. In order to reduce the likelihood that a device will interfere with these services, it is required that the amplitudes of radiated RF signals from the device are kept below an allowable level.

These RF signals decrease in strength as the distance from the source increases. Thus if the potential victim of interference, e.g. a TV receiver, is far enough from the radiator, e.g. a computer, then no interference will occur. For certain environments it is appropriate to expect that potential interference victims will be located at least a minimum distance from the radiator. For the residential environment this distance is generally accepted to be 10 meters while in the commercial environment the accepted distance is 30 meters. The allowable emissions levels are therefore specified to protect equipment which is located further than that distance from the radiator. In general, radiation from the Equipment Under Test (EUT) is measured at 3 or 10 meters to insure that it is at or below allowable levels.

Measurements of the radiated energy are made by recording the field strength indicated by an antenna placed at a specific distance from the device. Most devices do not radiate the RF energy in a predictable manner. The emitted energy may vary with changes in operating mode, physical configuration, or orientation. During the measurement process these parameters are varied to confirm that the emissions will remain below the allowable levels in the range of typical installations.

The extent of annoyance experienced by a person who is being affected by interference is related to the persistence of the interfering signal. For example, a low level steady whine from a receiver is considered to be more annoying than brief, loud, intermittent pops or clicks. This “human factor” is accounted for by the use of a “quasi-peak” detector in the receiver or spectrum analyzer which measures the signal from the measurement antenna. The detector is a weighted averaging filter with a fast charge time and a slow discharge time. Thus steady continuous signals will charge the quasi-peak detector fully while intermittent signals (those with pulse repetition rates less than 1kHz) are reported at a level which can be significantly below their peak level. It should be noted that most RF signals produced by digital devices are continuous in nature and thus the quasi-peak reading will be identical to the peak signal reading. To reduce the test time, the peak emission level is recorded for continuous wave signals as it is the same as the quasi-peak signal level.

Testing is performed according to test methods from ANSI C63.4 and CISPR 22.

The test site used for measuring radiated emissions follows the format developed internationally for a weather protected Open Area Test Site (OATS). The test site used for measuring radiated emissions above 1GHz for CISPR limits is a Free Space Open Area Test Site (FSOATS). An antenna mast is installed at the specified distance from a rotating table and is used to raise and lower the measuring antenna. The reference site is clear of reflecting objects, such as metal fences and buildings for an ellipse of twice the measurement test



distance. Measuring equipment and personnel are present within the ellipse to facilitate cable manipulation, but measures are taken to minimize the effects. Often preliminary radiated emissions measurements are made at alternate test sites which do not meet the clear space reference criteria. The data collected at alternate test sites is not considered conclusive unless the alternate site also complies with a volumetric site attenuation survey performed over the area that the EUT occupies. The EUT and measuring antenna mark the two foci of the ellipse. The ground plane is made of a combination of galvanized steel sheets and tight wire mesh electrically connected along the seams. This metal ground plane extends 1 meter beyond the furthest extent of the EUT and the measuring antenna. It also covers the area between the EUT and the measuring antenna. The hardware cloth is connected to the utility ground or to stakes driven into the earth for safety. The site configuration for CISPR testing above 1GHz is a semi-anechoic chamber. The ground plane in the test volume is covered by an absorbing material between the antenna and the EUT. In the case of table top equipment, the absorbing material is also placed under the table. In the case of floor-standing equipment the absorbing material extends up from the ground plane 30cm into the test volume, and surrounds the EUT by at most 10cm from the footprint of the equipment.

In order for accurate emissions measurements to be made the test site must possess propagation characteristics which fall within accepted norms. The site has been checked for suitability using techniques specified in American National Standards Institute (ANSI) document C63.4. This document details a procedure which measures the attenuation of the site which is the chief indicator of site acceptability. The theory behind site attenuation is quite simple. A transmitting antenna is set up at a fixed location at one end of the site with a receiving antenna at the other end. If a signal of some arbitrary amplitude is fed into the transmitting antenna, a lesser amount of signal ought to be measured at the receiving antenna. This difference in signal amplitude is known as the site attenuation, which should follow a predicted curve. Data that does not correspond to the predicted site attenuation curve points to a problem with either the equipment being used or the physical characteristics of the site.

Actual emissions measurements are taken with broadband biconical-log-periodic hybrid antennas calibrated in accordance with the standard site method detailed in ANSI C63.5. Emissions are measured with the receiving antenna oriented in horizontal and vertical polarization with respect to the ground plane. If measurements are made at other than the limit distance, then the readings obtained are scaled to the limit distance using an inverse relationship. The actual test distance used is noted in the report.

The antenna mast is capable of a varying the antenna height between 1 and 4 meters above the ground plane. The receiving antenna is moved over this range at each emission frequency in order to record the maximum observed signal. The mast is non-conductive and remotely controllable. The test distance is measured from the antenna center (marked during calibration) and the periphery of the EUT.

The Equipment Under Test (EUT) is rotated in order to maximize emissions during the test. For equipment intended to operate on a tabletop or desk radiated tests are conducted on a 0.8 meter high, non-conductive platform. Larger floor standing equipment is tested on a floor mounted rotatable platform. In some cases, large equipment on its own casters may be tested without a platform.



Since radiated emissions are a function of cable placement, the cable placement is varied to encompass typical configurations that an end user might encounter to determine the configuration resulting in maximum emissions. At least one cable for each I/O port type is attached to the EUT. If peripherals or modules are available, at least one of each available type is installed and noted in the report. Excess cable length beyond one meter is bundled in the center into a 30 to 40 cm bundle. Cables requiring non-standard lead dress are recorded in the report.

Network connections are simulated if necessary. Any simulator used matches the expected real network connection in terms of both functionality and impedance. For distributed systems, the support equipment may be placed at such a distance that it does not influence the measured emissions. If this option is used, such placement is noted in the test report.

The possible operating modes of the EUT are explored to determine the configuration which maximizes emissions. Software is investigated as well as different methods of displaying data if available. Data is recorded in the worst case operating mode.

At least the six highest emissions with respect to the limit are recorded. If less than six emissions are visible above the noise floor of the instrumentation, then noise floor measurements at six representative frequencies are recorded. The test report will document if noise floor readings are reported.

FCC and European Norms Radiated Emissions Limits at 10 meters					
Frequency (MHz)	FCC Class A	FCC Class B	CISPR Class A	CISPR Class B	Frequency (MHz)
30-88	39.1	29.5	40	30	30-88
88-216	43.5	33.1	40	30	88-216
216-230	46.4	35.6	40	30	216-230
230-960	46.4	35.6	47	37	230-960
960-1000	49.5	43.5	47	37	960-1000
1000-3000	Avg: 49.5 Peak: 69.5	Avg: 43.5 Peak: 63.5	Not defined	Not defined	1000-3000
3000+	Avg: 49.5 Peak: 69.5	Avg: 43.5 Peak: 63.5	Not defined	Not defined	3000+
<p>At the transitions, the lower limit applies. Simple inverse scaling utilized to convert limits where appropriate.</p>					

FCC and European Norms Radiated Emissions Limits at 3 meters					
Frequency (MHz)	FCC Class A	FCC Class B	CISPR Class A	CISPR Class B	Frequency (MHz)
30-88	49.5	40	50.5	40.5	30-88
88-216	54	43.5	50.5	40.5	88-216
216-230	56.9	46	50.5	40.5	216-230
230-960	56.9	46	57.5	47.5	230-960
960-1000	60	54	57.5	47.5	960-1000





1000-3000	Avg: 60 Peak: 80	Avg: 54 Peak: 74	Avg: 56 Peak: 76	Avg: 50 Peak: 70	1000-3000
3000+	Avg: 60 Peak: 80	Avg: 54 Peak: 74	Avg: 60 Peak: 80	Avg: 54 Peak: 74	3000+
<p>At the transitions, the lower limit applies.</p> <p>Simple inverse scaling utilized to convert limits where appropriate.</p>					

The measurement range is based on the highest frequency signal present or used in the device. The following table details the frequency range of measurements performed.

Frequency range of radiated emissions measurements		
Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)  FCC	Upper frequency of measurement range (MHz)  EU/CISPR
Below 1.705	30 (No radiated measurements)	1000
1.705-108	1000	1000
108-500	2000	2000
500-1000	5000	5000
Above 1000	5 <sup>th</sup> harmonic of the highest frequency 40 GHz whichever is lower.	5 <sup>th</sup> harmonic of the highest frequency 6 GHz whichever is lower.

The test data is derived from the voltage on the spectrum analyzer. First the reading is corrected for gain factors associated with the use of preamps and loss in the cable. A factor in dB is subtracted from the reading to account for preamp gain, while a factor in dB is added to the signal to account for cable loss. A conversion is performed from the resulting voltage to field strength by multiplying the voltage by the antenna factor. Since antenna factor is expressed as a logarithm (dB/m), this operation takes the form of an addition (to multiply logarithmic numbers, you add them together). Thus:

$$\text{Field Strength (dBuV/m)} = \text{Voltage Reading (dBuV)} - \text{Preamp Gain (dB)} + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

When the levels of ambient radio signals such as local television stations are within 6 dB of the appropriate limit, the following steps may be taken to assure compliance:

1. The measurement bandwidth may be reduced. A check is made to see that peak readings are not affected. The use of a narrower bandwidth allows examination of emissions close to local ambient signals.
2. The antenna may be brought closer to the EUT to increase signal-to-ambient signal strength.
3. For horizontally polarized signals the axis of the test site may be rotated to discriminate against local ambients.

**CONDUCTED EMISSIONS****Test Method:**

In accordance with the following:

- EN55022:2006/ A1:2007
- ICES-003 Issue 4
- 47 CFR FCC Part 15
- VCCI
- AS/NZS CISPR22:2006
- EN 62040-2:2006

**Results:**

TEST	RESULT	TEST LEVEL	MARGIN	COMMENTS
<b>AC Mains Conducted Emissions</b>	PASS	Class A	-4.6 dB @ 0.17 MHz	
<b>AC Output Conducted Emissions</b>	N/A	N/A	N/A	AC output cables are less than 10m

## Conducted Emissions Data Table(s):

Table 7

AC Mains Conducted Emissions										
Date: 05-Oct-10			Company: APC			Work Order: K1310				
Engineer: Andrew Chin			EUT Desc: Colt HV			Test Site: CEMI 6				
Temp: 21.1°C			Humidity: 45%			Pressure: 1014mBar				
Notes: AVR Full Load										
Measurement Device: Asset #1494 LISN						EUT Operating Voltage/Frequency: 220V/60Hz				
Range: 0.15-30MHz						Spectrum Analyzer: Red				
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor (dB)	FCC/CISPR A		FCC/CISPR A		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
0.15	45.4	46.3	33.6	33.5	20.1	79.0	-12.6	66.0	-12.3	Pass
0.17	48.6	48.4	41.3	40.1	20.1	79.0	-10.4	66.0	-4.6	Pass
0.19	41.5	41.7	35.1	36.0	20.1	79.0	-17.2	66.0	-9.9	Pass
1.55	16.2	16.7	10.6	8.0	20.0	73.0	-36.3	60.0	-29.4	Pass
3.93	26.4	27.6	21.0	17.2	20.1	73.0	-25.3	60.0	-18.9	Pass
13.76	17.0	15.8	10.1	10.0	20.2	73.0	-35.8	60.0	-29.7	Pass
Table Result: Pass by -4.60 dB Worst Freq: 0.17 MHz										

Table 8

AC Mains Conducted Emissions										
Date: 05-Oct-10			Company: APC			Work Order: K1310				
Engineer: Andrew Chin			EUT Desc: Colt HV			Test Site: CEMI 6				
Temp: 21.1°C			Humidity: 45%			Pressure: 1014mBar				
Notes: Green Full Load										
Measurement Device: Asset #1494 LISN						EUT Operating Voltage/Frequency: 220V/60Hz				
Range: 0.15-30MHz						Spectrum Analyzer: Red				
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor (dB)	FCC/CISPR A		FCC/CISPR A		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
0.15	46.3	46.5	27.2	25.4	20.1	79.0	-12.5	66.0	-18.7	Pass
0.17	46.4	45.9	25.0	27.3	20.1	79.0	-12.5	66.0	-18.6	Pass
0.19	39.1	40.2	24.0	18.2	20.1	79.0	-18.7	66.0	-21.9	Pass
0.68	25.4	22.0	3.5	3.0	20.1	73.0	-27.5	60.0	-36.4	Pass
9.07	9.7	7.9	4.6	1.0	20.1	73.0	-43.2	60.0	-35.3	Pass
14.22	14.7	14.3	5.5	9.6	20.2	73.0	-38.1	60.0	-30.3	Pass
Table Result: Pass by -12.50 dB Worst Freq: 0.15 MHz										

Table 9

AC Mains Conducted Emissions										
Date: 05-Oct-10			Company: APC			Work Order: K1310				
Engineer: Andrew Chin			EUT Desc: Colt HV			Test Site: CEMI 6				
Temp: 21.1°C			Humidity: 45%			Pressure: 1014mBar				
Notes: Battery Full Load										
Measurement Device: Asset #1494 LISN						EUT Operating Voltage/Frequency: Battery				
Range: 0.15-30MHz						Spectrum Analyzer: Red				
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor  (dB)	FCC/CISPR A		FCC/CISPR A		Overall Result  (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
0.15	37.6	36.8	10.5	10.0	20.1	79.0	-21.4	66.0	-35.4	Pass
0.30	23.8	20.9	11.4	8.3	20.1	79.0	-35.1	66.0	-34.5	Pass
0.95	20.0	11.3	5.6	2.4	20.0	73.0	-33.0	60.0	-34.4	Pass
1.90	19.5	13.4	15.0	8.8	20.0	73.0	-33.5	60.0	-25.0	Pass
8.23	15.2	14.7	9.0	7.5	20.1	73.0	-37.7	60.0	-30.9	Pass
13.89	16.0	15.8	11.0	11.7	20.2	73.0	-36.8	60.0	-28.1	Pass
Table Result:		Pass	by	-21.40 dB			Worst Freq:		0.15 MHz	



Rev: 23-Sep-2010

**Spectrum Analyzers / Receivers / Preselectors****LISNs/Measurement Probes****Conducted Test Sites (Mains / Telco)****Meteorological Meters**Weather Clock (Pressure Only)  
CEMI6 Thermohygrometer**Range**  
9kHz-1.8GHz**MN**  
8591E**Mfr**  
Agilent**SN**  
3441A03559**Asset**  
24**Cat**  
I**Calibration Due**  
10-Mar-2011**Range**  
10kHz-50MHz**MN**  
9252-50-R-24-BNC**Mfr**  
Solar**SN**  
84715**Asset**  
1494**Cat**  
I**Calibration Due**  
13-Apr-2011**FCC Code**  
719150**VCCI Code**  
C-3365, T-1580**Cat**  
III**Calibration Due**  
NA**MN**  
BA928  
35519-044**Mfr**  
Oregon Scientific  
Control Company**SN**  
C3166-1  
72457730**Asset**  
831  
1344**Cat**  
I  
II**Calibration Due**  
17-Mar-2011  
18-Aug-2011

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

**Conducted Emissions Modifications:**

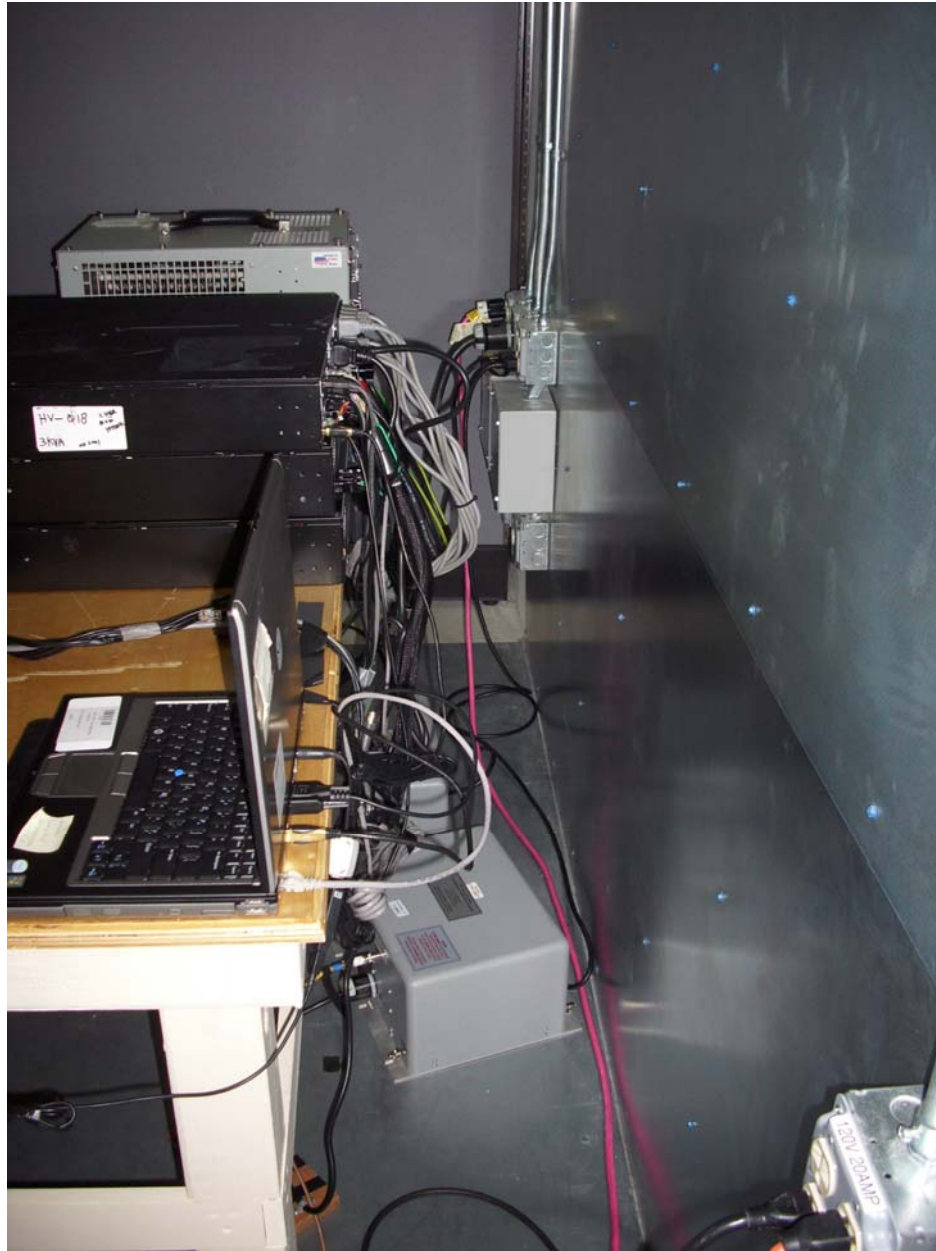
None



**Conducted Emissions Setup Photograph(s):**



**Front**



Rear

## Line Conducted Emissions Overview:

REV 9-MAY-06

Digital and microprocessor based devices use radio frequency (RF) digital techniques for timing purposes and in applications such as switching power supplies. An unintentional consequence of this for AC powered devices is that a certain amount of the RF energy is impressed upon the AC power mains in the form of a conducted noise voltage. These conducted emissions have the potential to interfere with constructive uses of the RF spectrum such as AM radio and may also interfere with other devices attached to the same AC mains circuit. In order to reduce the likelihood that a device will interfere it is required that the conducted RF signals from the device are below an allowable level.

Testing is performed according to test methods from ANSI C63.4 and CISPR 22.

Line conducted emissions are measured from the device over the frequency range of 0.15 to 30 MHz. The EUT is powered from a Line Impedance Stabilization Network (LISN). The purpose of the LISN is to provide a calibrated impedance across which to measure the conducted emissions. The RF noise voltage produced by the EUT across the LISN is measured and compared to the limit. In order for the LISN to perform properly it is attached to a ground plane at least 2 meters by 2 meters in size. For tabletop equipment the measurement is performed with the equipment 40 cm from a vertical conducting surface bonded to a ground plane under the product. The ground plane extends 0.5 meters beyond the product and is 2.5mx3.7m in size. The vertical surface is 2.5mx2.5m.

As with radiated emissions, the “human factor” is accounted for by the use of a “quasi-peak” detector in the receiver or spectrum analyzer that measures the signal from the LISN. For certain tests (such as EN55022), both an average and a quasi-peak limit are specified. Emissions from a device must be below both limits when measured with the appropriate detector. If the emission level is below the average limit when measured with the quasi-peak detector, the EUT is presumed to pass both limits.

The possible operating modes of the EUT are explored to determine the configuration that maximizes emissions. Software is investigated as well as different methods of displaying data if available. Data is recorded in the worst case operating mode.

As of September 9, 2002, the FCC has harmonized it's conducted emission limits with CISPR. The following table displays the limits applicable to both FCC and CISPR.



Line Conducted Emissions Limits: Class A (dB $\mu$ V)		
Frequency (MHz)	Quasi-Peak	Average
0.15 - 0.5	79	66
0.5 - 30	73	60
Line Conducted Emissions Limits: Class B (dB $\mu$ V)		
Frequency (MHz)	Quasi-Peak	Average
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5	56	46
5 - 30	60	50
Note 1: The lower limit applies at the transition frequencies		
*Note 2: The limit decreases linearly with the logarithm of the frequency		

At least the six highest emissions with respect to the limit are recorded. If less than six emissions are visible above the noise floor of the instrumentation, then the noise floor at six representative frequencies is recorded. The test report will document if noise floor readings are reported.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.



**TELCO CONDUCTED EMISSIONS****Test Method:**

- In accordance with EN55022:2006/ A1:2007, VCCI, and EN 62040-2:2006

**Results:**

TEST	RESULT	TEST LEVEL	MARGIN	COMMENTS
<i>Telco Line Conducted Emissions</i>	PASS	Class A	-12.90 dB @ 16.23 MHz	

## Conducted Emissions Data Table(s):

Table 10

Telco Conducted Emissions - Voltage										
Date: 06-Oct-10			Company: APC			Work Order: K1310				
Engineer: Andrew Chin			EUT Desc: Colt HV			Test Site: CEMI6				
Temp: 21.0°C			Humidity: 47%			Pressure: 1007.7mBar				
Notes: Green Full Load										
Measurement Device: 2-Pair Telco ISN (Asset #746)						EUT Operating Voltage/Frequency: 220V/60Hz				
Range: 0.15-30MHz						Spectrum Analyzer: Red				
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	Telco Voltage (A)		Telco Voltage (A)		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
0.30	42.5		30.5		9.9	91.3	-38.9	78.3	-37.9	Pass
0.60	41.4		36.1		9.9	87.0	-35.7	74.0	-28.0	Pass
0.90	41.7		34.7		9.9	87.0	-35.4	74.0	-29.4	Pass
16.23	54.3		51.2		9.9	87.0	-22.8	74.0	-12.9	Pass
23.13	52.5		50.8		9.9	87.0	-24.6	74.0	-13.3	Pass
26.61	51.4		49.1		9.9	87.0	-25.7	74.0	-15.0	Pass
Table Result:		Pass	by -12.90 dB		Worst Freq:		16.23 MHz			

Table 11

Telco Conducted Emissions - Voltage										
Date: 06-Oct-10			Company: APC			Work Order: K1310				
Engineer: Andrew Chin			EUT Desc: Colt HV			Test Site: CEMI6				
Temp: 21.0°C			Humidity: 47%			Pressure: 1007.7mBar				
Notes: AVR Full Load										
Measurement Device: 2-Pair Telco ISN (Asset #746)						EUT Operating Voltage/Frequency: 220V/60Hz				
Range: 0.15-30MHz						Spectrum Analyzer: Red				
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	Telco Voltage (A)		Telco Voltage (A)		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
0.30	42.7		30.3		9.9	91.3	-38.7	78.3	-38.1	Pass
0.60	40.7		36.0		9.9	87.0	-36.4	74.0	-28.1	Pass
0.97	41.1		36.9		9.9	87.0	-36.0	74.0	-27.2	Pass
16.23	54.4		51.1		9.9	87.0	-22.7	74.0	-13.0	Pass
23.13	52.5		50.8		9.9	87.0	-24.6	74.0	-13.3	Pass
26.61	51.4		42.2		9.9	87.0	-25.7	74.0	-21.9	Pass
Table Result: Pass by -13.00 dB Worst Freq: 16.23 MHz										

Table 12

Telco Conducted Emissions - Voltage										
Date: 06-Oct-10			Company: APC			Work Order: K1310				
Engineer: Andrew Chin			EUT Desc: Colt HV			Test Site: CEMI6				
Temp: 21.0°C			Humidity: 47%			Pressure: 1007.7mBar				
Notes: Battery Full Load										
Measurement Device: 2-Pair Telco ISN (Asset #746)						EUT Operating Voltage/Frequency: 220V/60Hz				
Range: 0.15-30MHz						Spectrum Analyzer: Red				
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	Telco Voltage (A)		Telco Voltage (A)		Overall Result  (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
0.30	43.9		30.5		9.9	91.3	-37.5	78.3	-37.9	Pass
0.60	44.8		36.0		9.9	87.0	-32.3	74.0	-28.1	Pass
0.97	45.3		37.2		9.9	87.0	-31.8	74.0	-26.9	Pass
2.00	51.8		48.4		9.9	87.0	-25.3	74.0	-15.7	Pass
14.21	51.7		48.7		9.9	87.0	-25.4	74.0	-15.4	Pass
23.13	52.5		50.8		9.9	87.0	-24.6	74.0	-13.3	Pass
Table Result: Pass by -13.30 dB Worst Freq: 23.13 MHz										



Rev: 23-Sep-2010

**Spectrum Analyzers / Receivers / Preselectors**  
Red

Range	MN	Mfr	SN	Asset	Cat	Calibration Due
9kHz-1.8GHz	8591E	Agilent	3441A03559	24	I	10-Mar-2011

**LISNs/Measurement Probes**

CISPR 22 2 Pair Telco ISN

Range	MN	Mfr	SN	Asset	Cat	Calibration Due
9kHz-30MHz	FCC-TLISN-T4	Fischer	20115	746	I	14-Jan-2011

**Conducted Test Sites (Mains / Telco)**

CEMI 6

**FCC Code**

719150

**VCCI Code**

C-3365, T-1580

**Cat**

III

**Calibration Due**

NA

**Meteorological Meters**

Weather Clock (Pressure Only)

CEMI6 Thermohygrometer

**MN**

BA928

35519-044

**Mfr**

Oregon Scientific

Control Company

**SN**

C3166-1

72457730

**Asset**

831

1344

**Cat**

I

II

**Calibration Due**

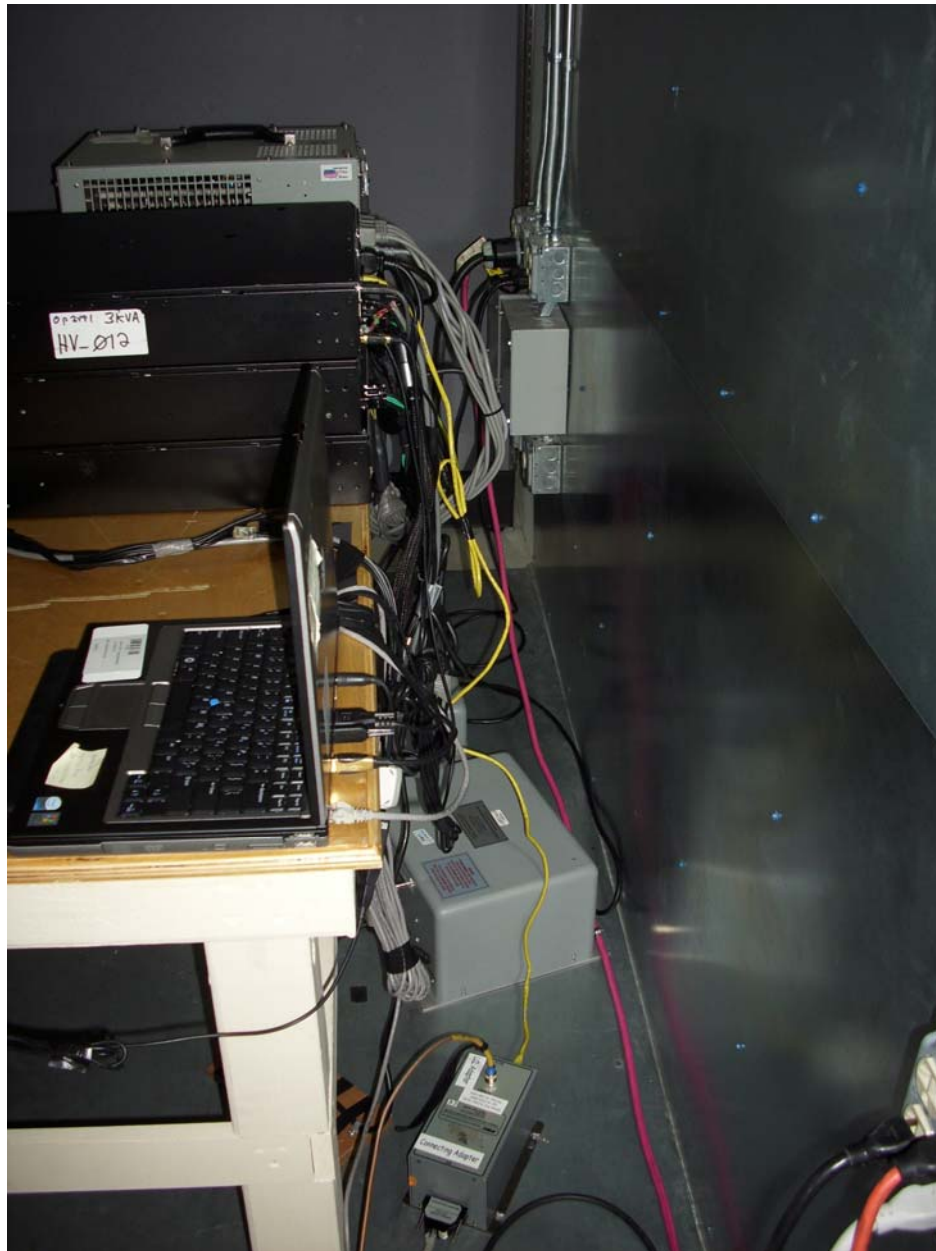
17-Mar-2011

18-Aug-2011

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.



**Telco Conducted Emissions Setup Photograph(s):**



## EN55022 Telco Cable Conducted Current Emissions Testing Overview

REV 13-Jul-09

Digital and microprocessor based devices use radio frequency (RF) digital techniques for timing purposes and in applications such as switching power supplies. An unintentional consequence of this is that a certain amount of the RF energy is impressed upon the telecommunications cables in the form of conducted common mode noise. These conducted emissions have the potential to interfere with other devices attached to the telecommunications signal cables. In order to reduce the likelihood that a device will interfere, it is required that the conducted RF signals from the device are below an allowable level.

Telecommunications ports as defined by the EN55022 standard are any ports which are intended to be connected to telecommunications networks (e.g. public switched telecommunications networks, integrated serviced digital networks), local area networks (e.g. ethernet, token ring) and similar networks.

No limits are defined for differential current or voltage signal levels in this standard. However, the maximum signal levels that can be present at telecommunication ports in differential mode are dependent upon, and are limited by, the electrical balance or longitudinal conversion loss (LCL) of the telecommunication ports and the cables or networks to which they are intended to be connected, if the wanted signals are not to appear as unacceptable disturbances across the common mode impedance to ground. The LCL of a signal port, cable, or network causes a portion of any differential signals on that port, cable, or network to be converted to common mode disturbances for which this standard has defined limits. Common mode disturbances (also called antenna mode disturbances because they are a source of radiated disturbances in the environment) must be limited if interference with the reception of radio signals of all kinds is to be minimized. Common mode disturbances created at a nominally balanced signal port or transmission medium, for example a twisted copper pair, must be controlled and limited whether or not the port or medium is provided with an overall shield. If a shielded medium is used, deficiencies in the shield itself as well as in the shield connectors — leading perhaps to significant electrical discontinuities — will allow a portion of the common mode disturbances created within the shield environment to appear outside the shield. The worst-case values for balance and LCL quoted in many network specifications are based upon the desired signal transmission and crosstalk performance of the networks and do not necessarily have regard for the control of the common mode disturbances considered in this standard.

Conducted common mode emissions at telecommunication ports are measured from the device over the frequency range of 0.15 to 30 MHz. The EUT is powered from a Line Impedance Stabilization Network (LISN). The purpose of the LISN is to provide a calibrated impedance for the AC power port. The RF noise voltage and current produced by the EUT is measured and compared to the respective limits.



<b><i>Class A limits of conducted common mode disturbance at telecommunication ports</i></b>				
<b>Frequency Range MHz</b>	<b>Voltage Limits dB(<math>\mu</math>V)</b>		<b>Current Limits dB(<math>\mu</math>A)</b>	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15 to 0.5	97 to 87	84 to 74	53 to 43	40 to 30
0.5 to 30	87	74	43	30

<b><i>Class B limits of conducted common mode disturbance at telecommunication ports</i></b>				
<b>Frequency Range MHz</b>	<b>Voltage Limits dB(<math>\mu</math>V)</b>		<b>Current Limits dB(<math>\mu</math>A)</b>	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15 to 0.5	84 to 74	74 to 64	40 to 30	30 to 20
0.5 to 30	74	64	30	20

For tabletop equipment the measurement is performed with the equipment 40 cm from the horizontal ground plane under the product. The ground plane extends 0.5 meters beyond the product and is 2.5mx3.7m in size. For shielded cables, the shield of the cable under test is terminated to the ground plane via a 150 $\Omega$  resistor placed 30-80cm from the EUT. Current measurements are made with a current clamp which is positioned between the EUT and the cable termination at a location to maximize the emission readings. Voltage measurements are optional for shielded cables, but can be measured across the termination. Unshielded cables are measured in the same fashion as shielded cables, but without the 150 $\Omega$  termination. Voltage measurements are required for unshielded cables and are measured using a capacitive voltage probe.

As with radiated emissions, the “human factor” is accounted for by the use of a “quasi-peak” detector in the receiver or spectrum analyzer which measures the signal from the probes. Both an average and a quasi-peak limit are specified. Emissions from a device must be below both limits when measured with the appropriate detector. If the emission level is below the average limit when measured with the quasi-peak detector, the EUT is presumed to pass both limits.

At least the six highest emissions with respect to the limit are recorded. If less than six emissions are visible above the noise floor of the instrumentation, then the noise floor at six representative frequencies is recorded. The test report will document if noise floor readings are reported.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 General requirements for the competence of calibration and testing laboratories and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.

**ELECTROSTATIC DISCHARGE IMMUNITY****Test Method:**

In accordance with EN 61000-4-2:2001.

**Results:**

TEST	RESULT	STANDARD	TEST LEVEL	COMMENTS
<b>ESD</b>	PASS	EN 61000-4-2	±8kV contact, ±10kV air	Performance Criteria B

## Electrostatic Discharge Immunity Data Table(s):

Table 13

ESD DATA SHEET						
<b>Work Order:</b> K1310 <b>Date:</b> 08-Oct-10 12-Oct-10 <b>Engineer:</b> Andrew Chin <b>EUT:</b> Colt HV <b>Company:</b> APC						
						<b>Client Present:</b> Yes
<b>Testing Location:</b> Littleton Distribution Center, One Distribution Center Circle, #1 Littleton, MA 01460						
<b>Performance Criteria:</b> B						
<b>Maximum Test Parameters:</b> ±8kV contact      ±10kV air <b>EUT Operating Voltage/Frequency:</b> 220Vac, 60Hz						
<b>Test Equipment Used:</b>						
<b>ESD Generators</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Green	NSG435	Schaffner	839	763	I	6/1/2011
<b>Oscilloscopes and Probes</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
ESD Reference 1GHz	TDS 684B	Tektronix	B011287	Rental	I	6/22/2011
<b>Meteorological Meters</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Weather Clock (Pressure Only)	BA928	Oregon Scientific	C3166-1	831	I	3/17/2011
EMC2 Thermohygrometer	35519-044	Control Company	72457653	1352	II	8/18/2011
EMC3 Thermohygrometer	35519-044	Control Company	72457727	1353	II	8/18/2011
<b>Atmospheric Conditions:</b>						
<b>Temp:</b> 24.6°C		<b>Humidity:</b> 33%		<b>Pressure:</b> 1002mbar		
<b>Temp:</b> 23.6°C		<b>Humidity:</b> 30%		<b>Pressure:</b> 1003mbar		
<b>Test Points:</b>	<b>Pass/Fail</b>	<b>Test Levels:</b>		<b>Comments:</b>		
Horizontal Coupling Plane	Pass	±2kV, ±4kV, ±6kV, ±8kV				
Vertical Coupling Plane	Pass	±2kV, ±4kV, ±6kV, ±8kV				
<b>Contact Discharge Test Points</b>	Pass	±2kV, ±4kV, ±6kV, ±8kV				
<b>Photo Label</b>						
All contact discharge points are labeled with a <b>C</b> on the photos provided.						
<b>Air Discharge Test Points</b>	Pass	±2kV, ±4kV, ±8kV, ±10kV				
<b>Photo Label</b>						
All air discharge points are labeled with an <b>A</b> . Points where a discharge occurred are listed below:						
<b>Discharge Point Description</b>		<b>Discharge Voltage</b>				
N/A						

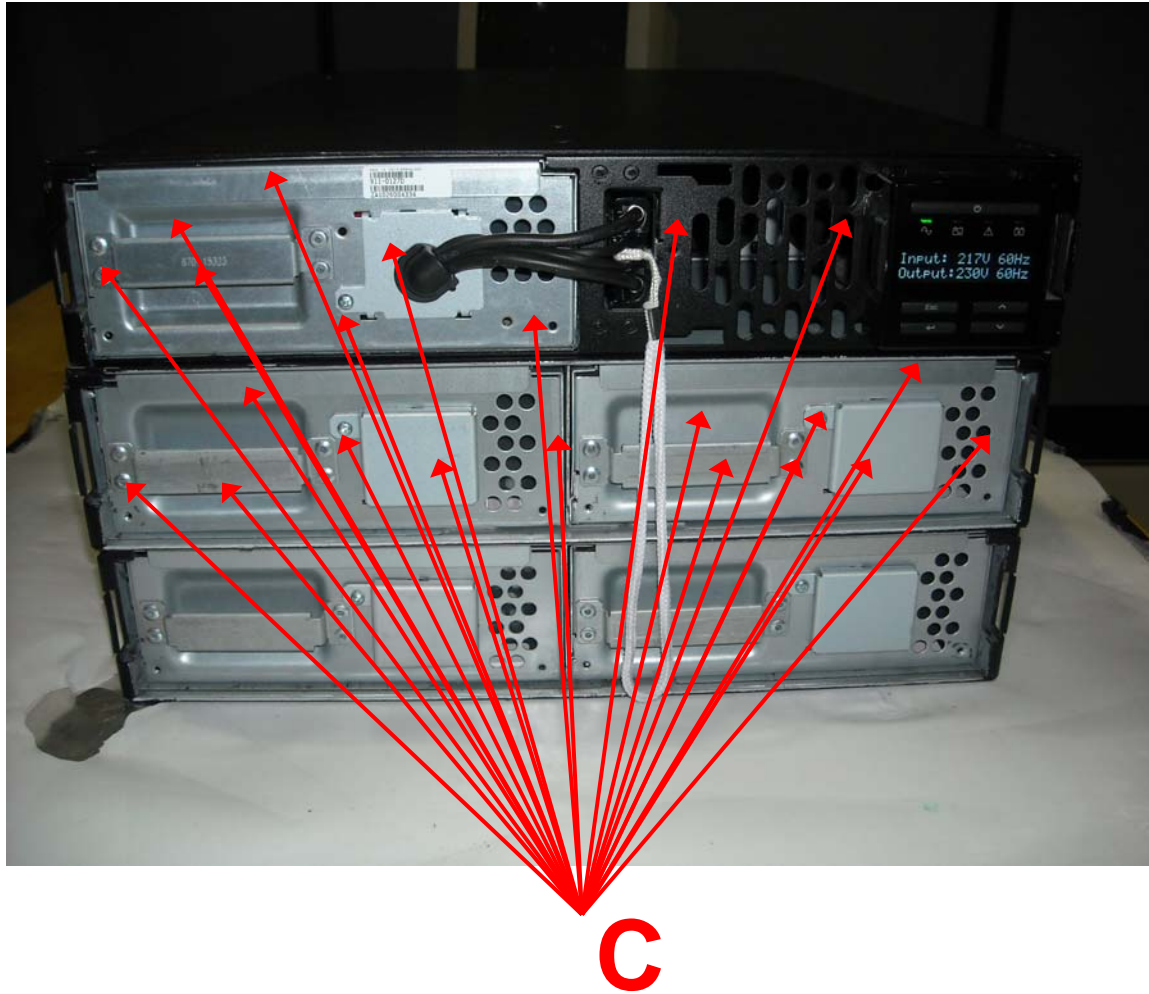
## ESD Modifications:

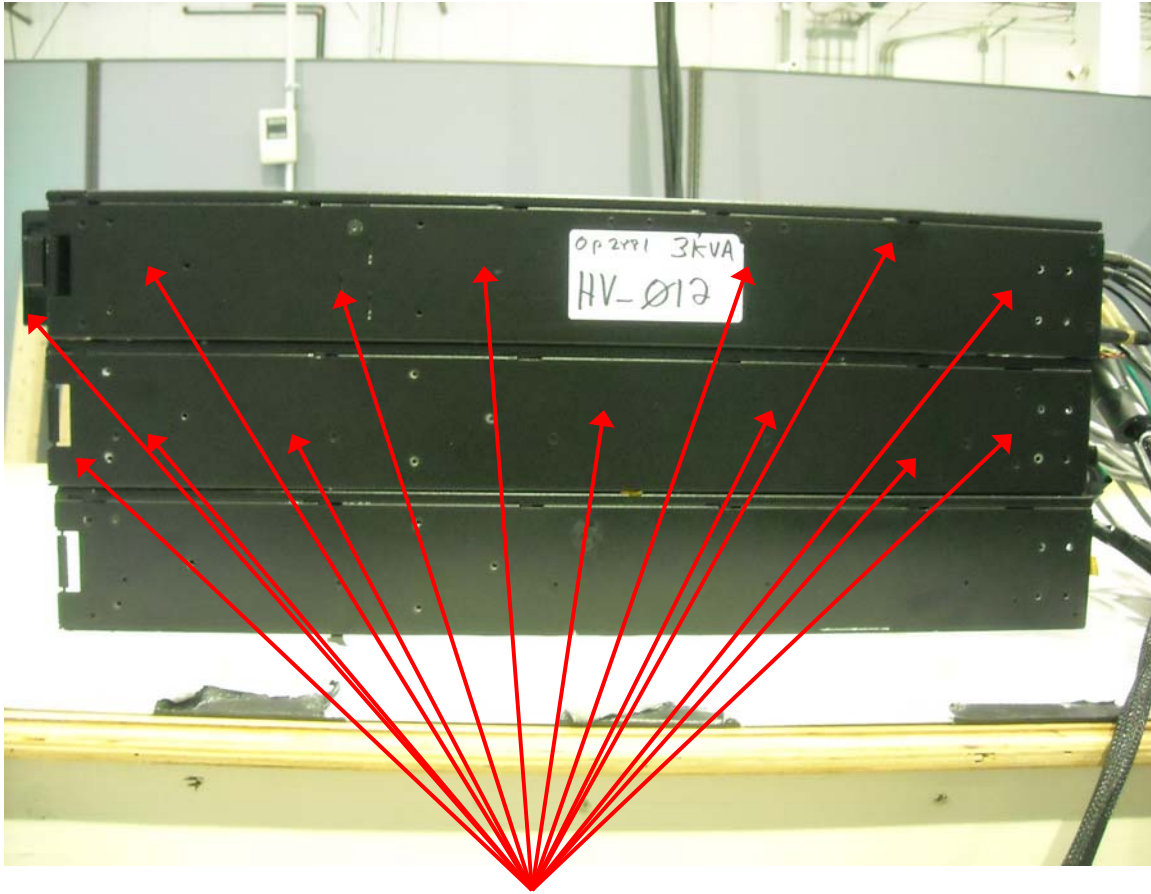
None



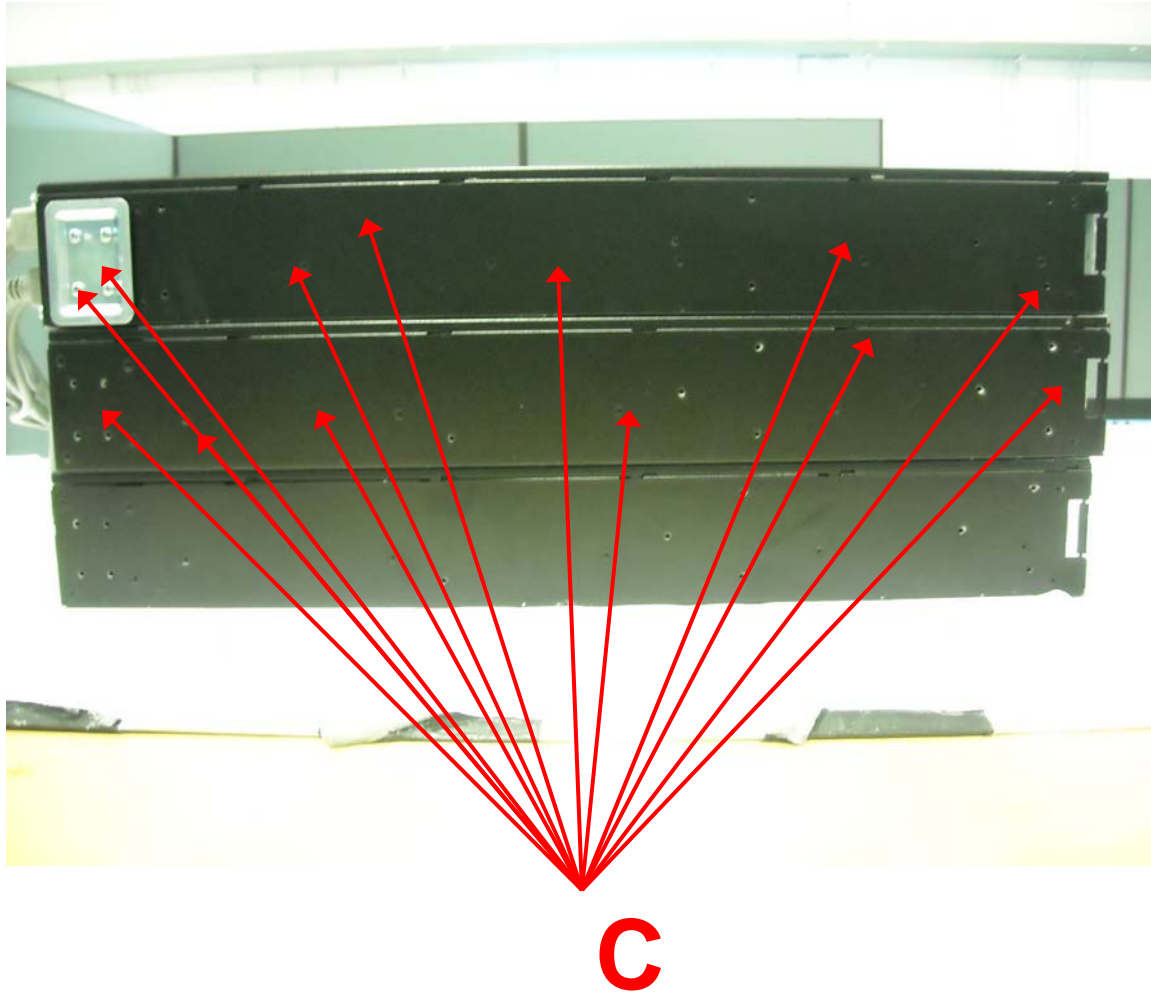


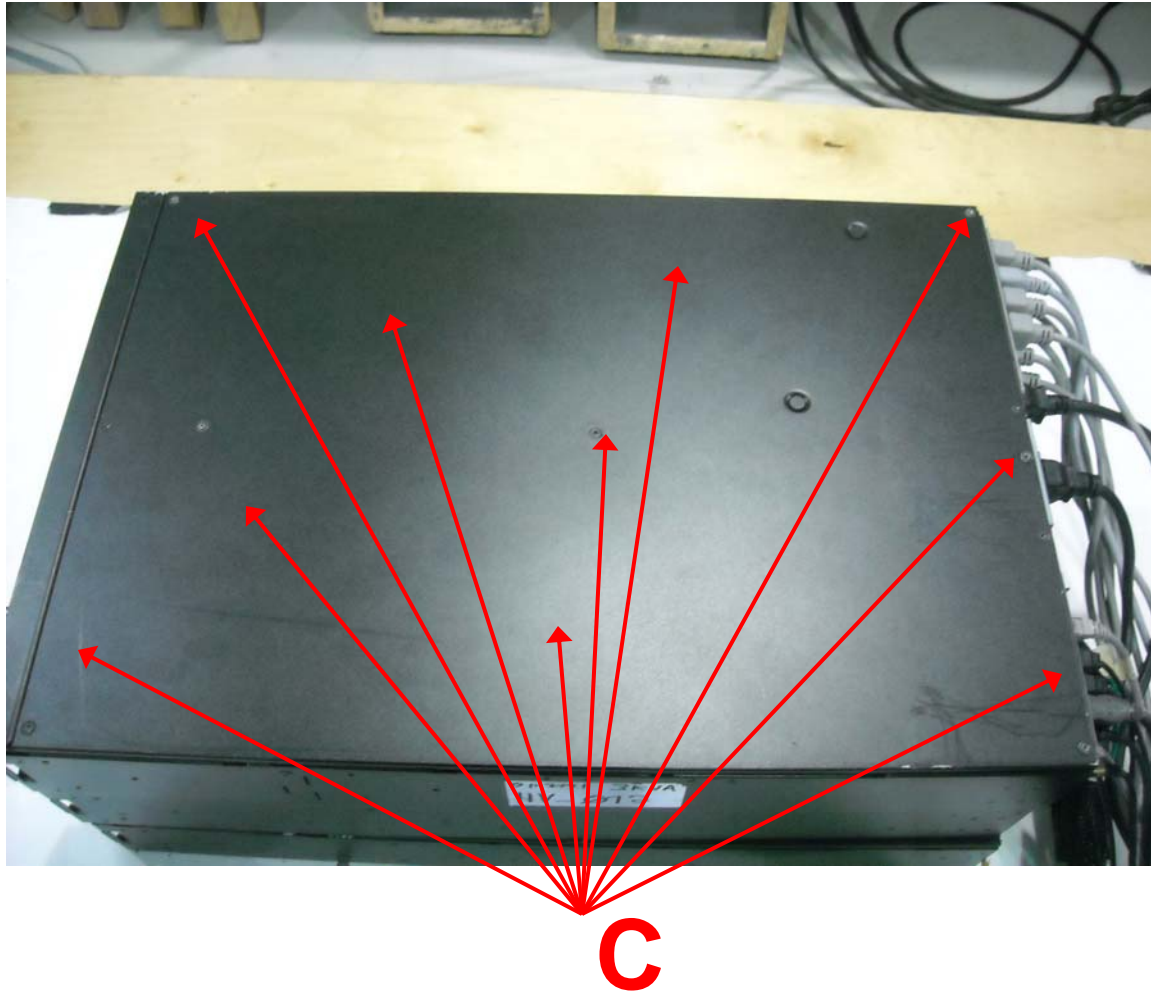
# Electrostatic Discharge Test Points:

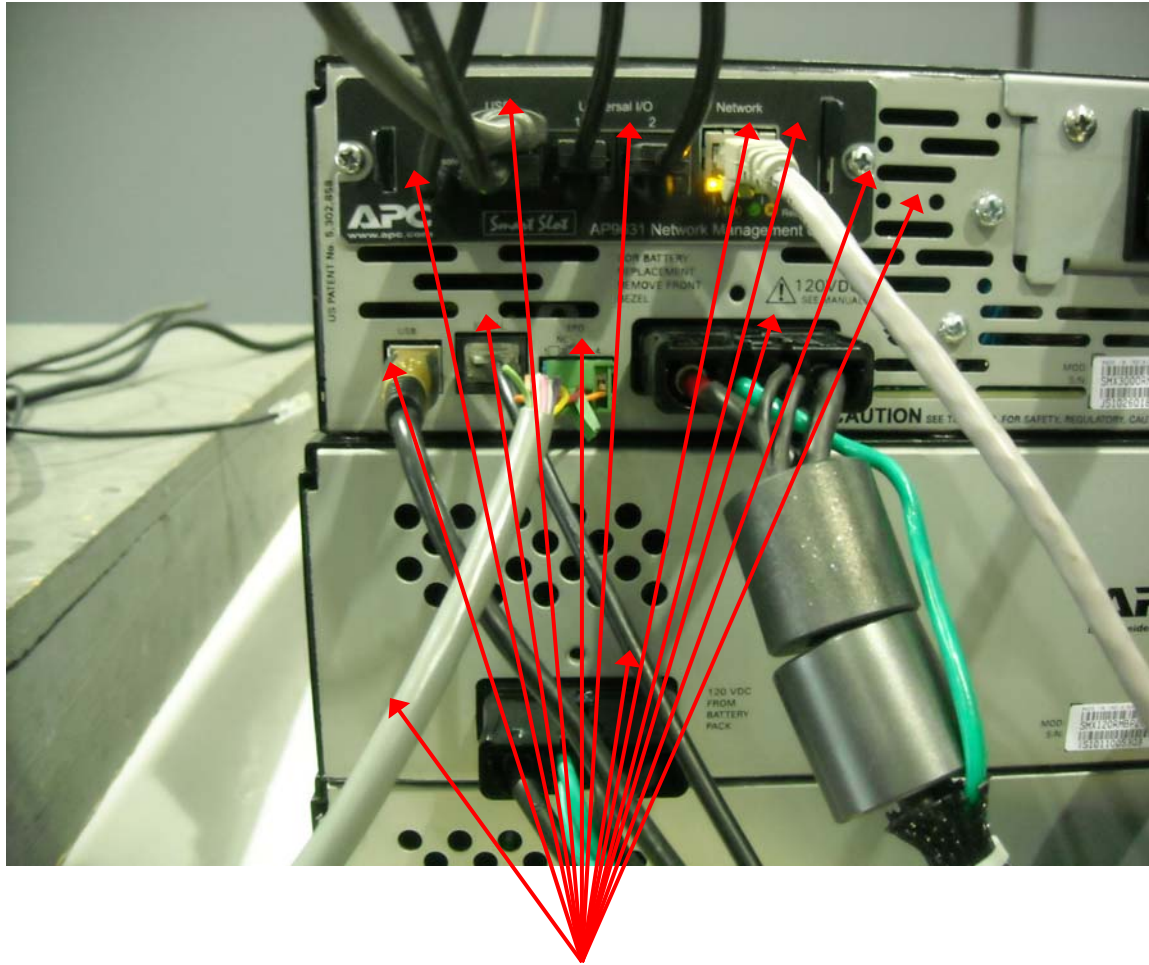




**C**

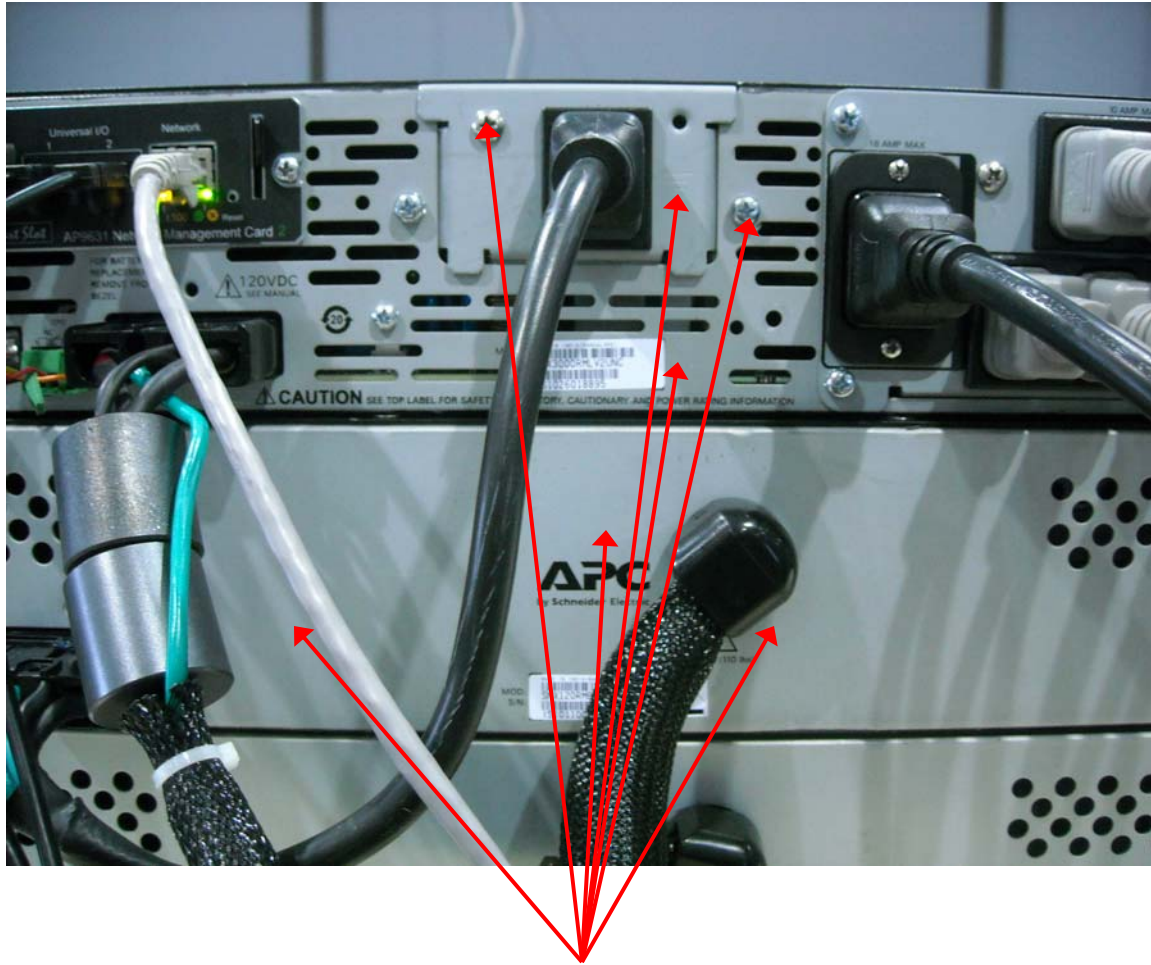




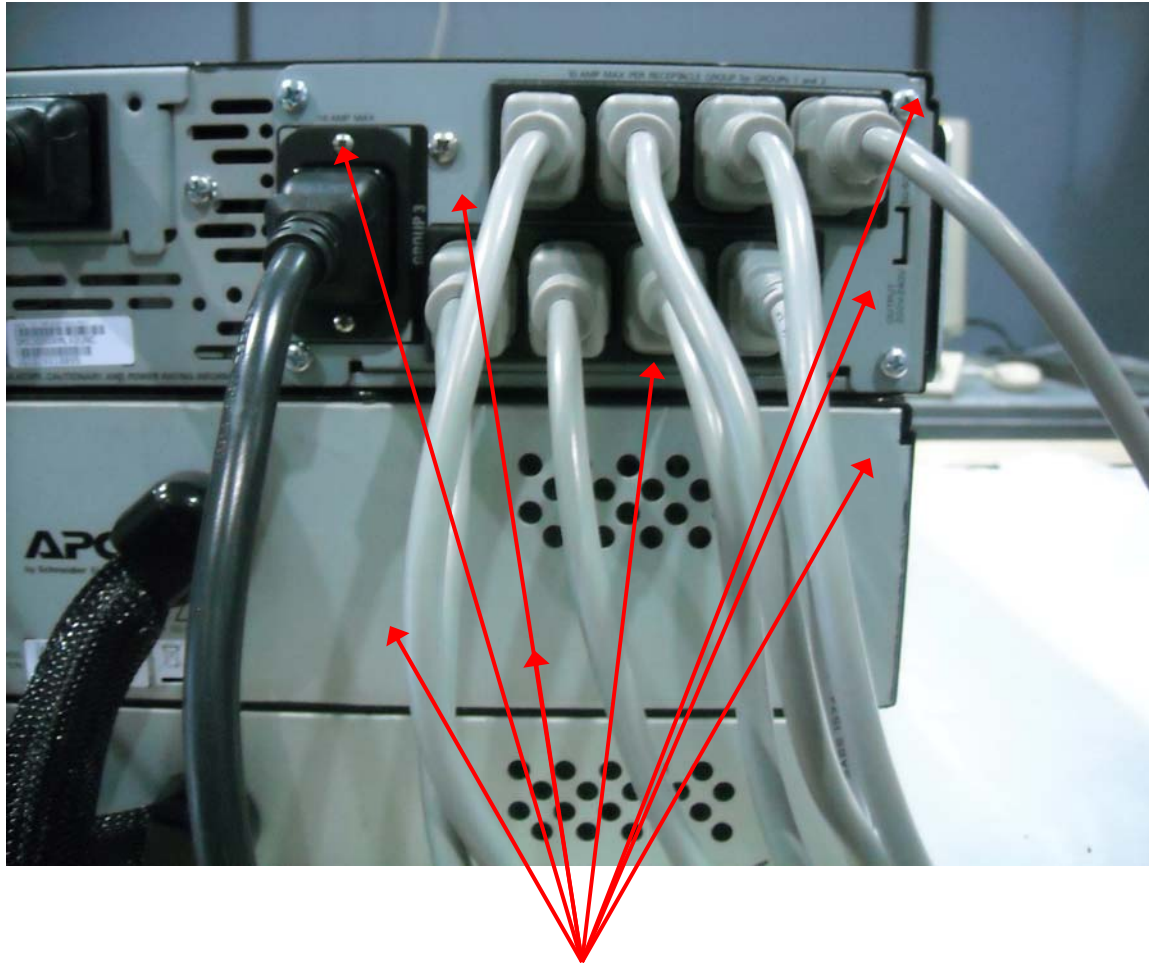


C

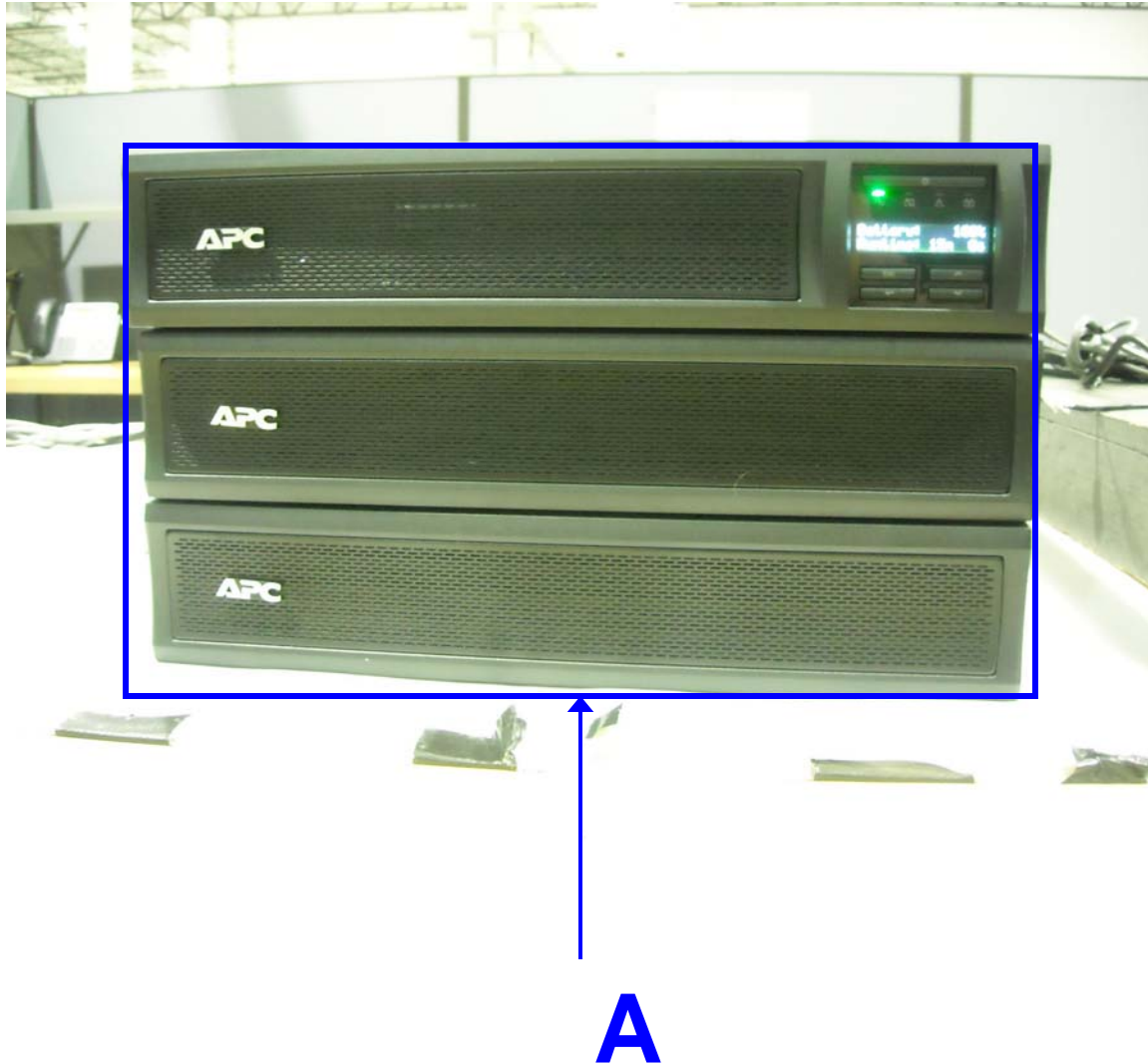




**C**



**C**



A



**Electrostatic Discharge Immunity Setup Photograph(s):**



## Electrostatic Discharge Testing Overview

REV 17-FEB-04

Electrostatic charges build up on isolated materials under various conditions. One such condition is the rubbing of two materials together. When this occurs, the materials develop opposing charges. If they are isolated, this charge does not dissipate and will continue to accumulate. At some high level of voltage, depending on the material types and spacing, the insulation will break down and the charge will rapidly migrate in an attempt to reach equilibrium. This is what is commonly referred to as "Electrostatic Discharge" (ESD).

One example of materials rubbing creating an electrostatic buildup through friction is that of shoes (rubber, plastic, leather, etc.) on carpet (nylon, etc.), as a result of walking. A human body exhibits a capacitance depending on several factors including physical size. This capacitance stores the charge created by walking or other motions which can cause charge storage. The level of the stored voltage is limited by the size of the capacitance (human body is typically 100-400 pF) and the effects of leakage and corona discharge. Once the body accumulates charge, contact with a neutral or oppositely charged item causes a rapid discharge. The shape of the discharge waveform, and the amplitude of the discharge current, depend in part on the distributed capacitance and series resistance of the human body. A lumped element model of these distributed elements is commonly referred to as a human body model. The values of the lumped elements of the human body model, as well as the maximum charge voltage, vary widely. The model currently selected for use in EN 61000-4-2 is 330 Ohm/150 pF, usually with a charge voltage of 4kV contact mode/ 8 kV air discharge mode.

EN 61000-4-2 is the basic procedure for ESD testing. The preferred discharge method specified in EN 61000-4-2 is referred to as "contact discharge". In this method, a charged internal 150pF capacitor is isolated from the probe tip by a mechanical relay (typically filled with sodium hexafluorine gas). The tip is applied to a nearby metal surface or metal points on the product that the user may touch. The relay is then closed and the arc occurs within the relay, transferring the charge on the cap down the tip. If the product has insulated surfaces, then the "air discharge" method is also employed. In this method the relay is closed while the tip is at a great distance from the product. The tip is then brought to the insulated parts of the product at high speed. If an arc over occurs (though the insulation or more typically through cracks or slots) then that area is subject to more ESD stimulation.

For air discharge the high approach speed is especially important. As the length of the ionized air gap changes, it is necessary to control this variable. Some control can be exerted by making the discharge electrode approach the device under test at high speed. This high approach speed makes test results more repeatable because it reduces the variability of the discharge impedance.

The test site is assembled on top of a ground plane made of overlapping galvanized steel sheets 2.5m x 3.5m. The ground plane is connected to safety earth. Table top equipment is tested on an .8mx1.6m non-conductive table placed on this ground plane. If the tabletop system is especially large a second, separate table is added to support the additional equipment. A sheet of galvanized steel is placed on the tabletop. This plate is connected to the lower ground plane by a wire with 470k Ohm resistors at each end. The plate is called the



Horizontal Coupling Plane (HCP). An additional .5mx.5m galvanized steel plate is used as a Vertical Coupling Plane (VCP). The VCP is also connected to the lower ground plane via a wire with 470k Ohm resistors at each end. Tabletop EUTs are isolated from the HCP by an insulator <.5mm thick. Typically a plastic sheet is employed. Floor standing equipment is tested on a 10cm insulator on top of the ground plane. For floor standing EUT configurations which do not have a tabletop component, an HCP is not part of the test setup as the ground plane is not an HCP. The EUT is grounded as normally installed.

The test begins with discharges to the HCP (if present) and VCP. All discharges are applied only in the contact discharge mode. 15 discharges are applied to the HCP 10cm from the EUT, at each of the four sides of the EUT at each voltage and polarity. Every voltage step of 2, 4, 6, 8kV is explored if below or equal to the maximum voltage to be applied. 15 discharges are also applied to the VCP held in four positions so that it illuminates in turn the four sides of the EUT. For large distributed floor standing systems, additional illumination points for the HCP and VCP are usually explored and will be noted in the test report. For EN55024, a minimum of four discharge points may be selected; this includes the coupling planes as well as the contact and air discharge points. The front center of the HCP must be one of the discharge points selected.

Once the indirect discharges to the coupling planes are done, testing moves on to direct discharges to the product itself. If the product is totally metal, only direct discharges are applied as that is the preferred mode. Air discharges are not performed to metal areas of the product. If the product has areas covered with an insulating material than those areas are subject to an air discharge test to see if an arc occurs. Contact discharges are not performed to insulated areas of the product. Some products are tested with only contact discharge (exclusively metal products) and some with only air discharge (insulated products such as those with plastic enclosures). Every voltage step in the standard is explored up to and including the maximum specified in the test. Thus 2 and 4 kV would be applied in a 4kV test. Each point subject to final ESD testing is noted in the test report.

While humidity is important in the charging of actual humans, it is much less important in the testing environment where a power supply within the ESD simulator controls very exactly the test voltage applied. For humans, the upper charging voltage achieved is limited by the bleed off of charge through the humidified atmosphere. EN 61000-4-2 requires air discharge testing to be performed with humidity in the range of 30% to 60%. Due to the lack of influence of humidity on ESD testing with ESD simulators operated with high approach speeds, we will occasionally perform testing outside of this range when atmospheric conditions warrant. Actual humidity conditions during the test are recorded on the test data sheet.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.



**RADIATED RADIO-FREQUENCY IMMUNITY****Test Method:**

In accordance with EN 61000-4-3:2008.

**Results:**

TEST	RESULT	STANDARD	TEST LEVEL	COMMENTS
<i>RFI</i>	PASS	EN 61000-4-3	27 - 6000 MHz 10 V/m 80% AM (1 kHz)	Performance Criteria A

## Radiated RF Immunity Data Table(s):

Table 14

RFI DATA SHEET							
<div>Work Order: K1310</div> <div>Date: 11-Oct-1012-Oct-10</div> <div>Engineer: Andrew Chin</div> <div>EUT: Colt HV</div> <div>Company: APC</div> <div>Client Present: No</div>							
Testing Location: Littleton Distribution Center, One Distribution Center Circle, #1 - Littleton, MA 01460							
<div>Performance Criteria: A</div> <div>EUT Cycle Time: Continuous</div> <div>Frequency Range: 27-6000MHzEUT Operating Voltage/Frequency: 220Vac, 60Hz</div> <div>Maximum Test Parameters: 10V/mClock Frequencies: 48, 100, 200MHz</div> <div>Modulation: 80% AM @ 1kHzDwell Frequencies: 80, 120, 160, 230, 434, 460, 600, 863, 900MHz</div>							
Test Equipment Used:							
RFI Systems	Range	MN	Mfr	SN	ASSET	Cat	Calibration Due
RFI 1 - 500W Amp - Yellow-Black Bilog	20 - 250MHz						3/16/2011
RFI 1		3 Meter Compact	Panashield	N/A	797	II	
500W Amp	0.1-250MHz	500A250	AR	326385	1297	II	
Yellow-Black Bilog	20-2000MHz	CBL6140A	Chase	1112	126	II	
RFI 1 - Yellow Amp - Yellow-Black Bilog	80 - 1000MHz						3/16/2011
RFI 1		3 Meter Compact	Panashield	N/A	797	II	
Yellow Amp	80-1000MHz	150W1000	AR	324607	1253	II	
Yellow-Black Bilog	20-2000MHz	CBL6140A	Chase	1112	126	II	
RFI 1 - High 1b - Red Horn - EU	1 - 2GHz						5/17/2011
RFI 1		3 Meter Compact	Panashield	N/A	797	II	
High 1	1.0-2.6 GHz	GRF5016A	GTC	1221	Rental	II	
High 1b	1.0-2 GHz	8020H09R000	Hughes	206	Rental	II	
Red Horn	1-10GHz	3115	EMCO		Rental	II	
RFI 1 - High 2 - Red Horn - EU	2 - 4GHz						10/21/2010
RFI 1		3 Meter Compact	Panashield	N/A	797	II	
High 2	2.0-4.0GHz	1177H01	Hughes	55	Rental	II	
Red Horn	1-10GHz	3115	EMCO		Rental	II	
RFI 1 - High 3 - Red Horn - EU	4 - 6GHz						10/21/2010
RFI 1		3 Meter Compact	Panashield	N/A	797	II	
High 3	4.0-8.0 GHz	8010H02F	Hughes	197	Rental	II	
Red Horn	1-10GHz	3115	EMCO		Rental	II	
Field Probes	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Blue	0.01-1000MHz	HI-4422	Holaday	95696	1100	I	5/4/2011
Signal Generators	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Green	0.09-2000MHz	HP8648B	Agilent	3623A02072	125	I	11/3/2010
Rental RFI-High Sweeper	0.01-20.0GHz	HP83752A	Agilent	3610A01340	Rental	I	8/10/2011
Meteorological Meters		MN	Mfr	SN	Asset	Cat	Calibration Due
Weather Clock (Pressure Only)		BA928	Oregon Scientific	C3166-1	831	I	3/17/2011
RFI1 Thermohyrometer		35519-044	Control Company	90823034	1499	II	3/20/2011
Cables	Range		Mfr			Cat	Calibration Due
CRFI-RFI-05	9kHz - 2GHz		C-S			II	4/6/2011
CRFI-RFI-29	9kHz - 2GHz		C-S			II	9/15/2011
RFI-High-04	1GHz - 10GHz		C-S			II	5/13/2011
RFI-High-08	1GHz - 10GHz		C-S			II	5/13/2011
Atmospheric Conditions:							
Temp: 24.0°C		Humidity: 32%		Pressure: 1002mbar			
Temp: 23.6°C		Humidity: 30%		Pressure: 1003mbar			
Results:							
	Front	Right	Back	Left	Comment		
Horizontal	Pass	Pass	Pass	Pass			
Vertical	Pass	Pass	Pass	Pass			

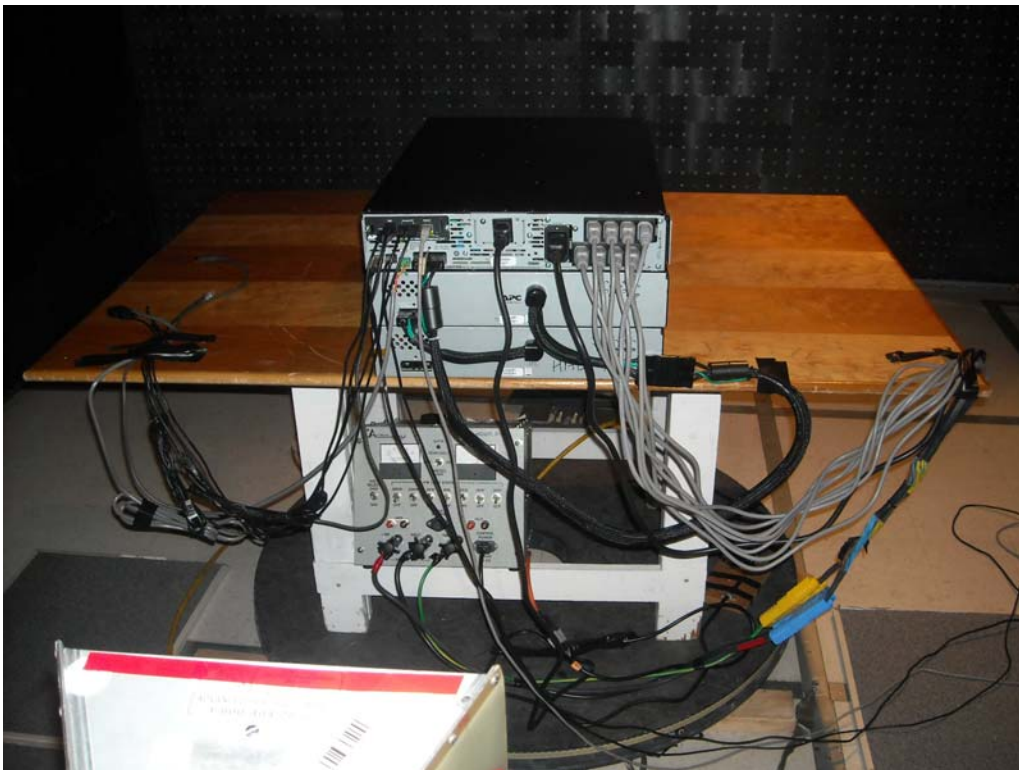




**Radiated RF Immunity Setup Photograph(s):**



**27-1000MHz**



**1-6GHz**

## Radiated RF Immunity Testing Overview

REV 13-SEP-07

Radiated fields result from many sources. In today's environment the RF spectrum is crowded by broadcast media (radio and TV), cellular phone systems, telemetry, amateur radio, radio navigation aids, industrial scientific, medical (ISM) devices, etc. All of which have the potential to disturb electronic products.

The development of test standards is based on statistical analysis of various RF sources within these allocations. In some rare cases, electrical field levels can reach hundreds of volts per meter (e.g. - an installation close to a high power broadcast transmitter). At other, remote locations, fields are usually less than 1 V/m. Modulation types and levels also vary from site to site.

The generic immunity standard for residential, commercial and light industrial environments EN 50082-1 and EN61000-6-1 specify the EN 61000-4-3 test methodology and applies a field intensity level of 3 V/m in the frequency range of 80 to 1000 MHz. The 3V/m field intensity, which corresponds to Severity Level 2 as specified in EN 61000-4-3, is generated with 1kHz, 80% depth amplitude modulation.

The generic heavy industrial immunity specification EN 61000-6-2 specifies the EN 61000-4-3 test methodologies. It applies a field intensity level of 10 V/m in the frequency range of 80 to 1000 MHz with reductions to 3 V/m in the European TV bands of 87-108 MHz, 174-230 MHz, and 470-790 MHz. The 3V/m field intensity, which corresponds to Severity Level 2 as specified in EN 61000-4-3, is generated with 1kHz, 80% depth amplitude modulation. Other test levels and frequency ranges may be explored depending on client request. Frequency ranges, field strength levels, and modulation schemes are recorded on the test data sheets.

The field levels specified in EN 61000-4-3, while generally lower than accepted safe human exposure levels, can cause harmful interference to communications and other electronics. For this reason, testing for radiated immunity must be conducted in a controlled area. This controlled area may be a RF shielded enclosure, a Transverse Electromagnetic (TEM) cell (also known as a Crawford cell) or an RF absorber lined shielded enclosure. Most testing is performed in a shielded enclosure.

Power is applied to the EUT in its normal operating condition either through an AC power cord, from an external power supply or battery. In the case of DC units, the power supply or battery is placed on the floor of the shielded enclosure.

Any Test Support Equipment (TSE) which is used to operate or monitor the performance of the EUT is placed either outside of the shielded enclosure or at such a distance that it is unaffected by the field. In cases where cable length prohibits placement of the TSE outside the enclosure, the TSE is placed on the enclosure floor or otherwise isolated from the radiated field. Unless specified by the manufacturer, all interface cabling used is twisted pair wire which is unshielded for at least 1m from the EUT. I/O cables are terminated in their normal resistance as specified by the manufacturer. All cables beyond 1m may be shielded to prevent additional coupling. All cables which exit the shielded enclosure are filtered or suppressed using ferrite beads to prevent affecting the TSE.

In cases where no TSE is used to monitor EUT performance, a closed circuit TV camera may be set up inside the shielded enclosure. The camera is used to monitor any performance





indications. The TV monitor can be located outside the enclosure and the EUT is observed for performance deviations during testing.

The RF field is generated by linearly polarized antennas such as bicon/log periodic hybrid antennas. The antenna is set up at a distance of 1m from the EUT. A signal generator is set up outside of the enclosure and connected by a coaxial cable to a 10 watt broadband amplifier. The output of the amplifier is connected via coaxial cable to the transmitting antenna. An isotropic field probe is placed near the EUT to monitor the field strength present at the EUT.

For EN 61000-4-3 and similar standards, the signal generator and amplifier are adjusted by a leveling computer to generate a constant field as the signal generator is tuned from 80 to 1000 MHz at a rate of approximately 10 minutes per decade (.0015 decades/second). Step size for the frequency tuning is 1%. As the frequency is tuned, the signal generator output amplitude is adjusted by the computer to maintain the required field strength. The amplitudes are then reproduced for the desired immunity disturbance level once the EUT is configured inside the enclosure. In each frequency band, the test is performed with the antenna in both horizontal and vertical polarization, for each of the 4 sides of the EUT.

For EN 61000-4-3, the enclosure is calibrated without the EUT present. The 1.5m x 1.5m field is uniform within 0 to +6dB of the calibration level. At the 40cm height, the field is uniform within -12 to +6dB of the calibration level. The distance between the UFA and the antenna is 3m.

In the event of an operating anomaly, the transmitting frequency and the nature of the anomaly is recorded. The field strength is reduced until the normal operation is restored. This field strength is recorded as the threshold of susceptibility. After the device is characterized in the required environment, modifications are made to the EUT to improve immunity as appropriate. In some cases, the EUT is extremely sensitive at several frequencies. In these instances, characterization testing may be terminated early to preclude damage.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.



**ELECTRICAL FAST TRANSIENTS IMMUNITY****Test Method:**

In accordance with EN 61000-4-4:2004.

**Results:**

TEST	RESULT	STANDARD	TEST LEVEL	COMMENTS
<i>EFT</i>	PASS	EN 61000-4-4	±4kV AC mains, ±2kV other	Performance Criteria B

**Electrical Fast Transient Burst Immunity Data Table(s):****Table 15**

EFT DATA SHEET						
<div>Work Order: K1310</div> <div>Date: 06-Oct-10    08-Oct-10</div> <div>Engineer: Andrew Chin</div> <div>EUT: Colt HV</div> <div>Company: APC</div> <div>Client Present: Yes</div>						
Testing Location: Littleton Distribution Center, One Distribution Center Circle, #1 Littleton, MA 01460						
Performance Criteria: B						
Maximum Test Parameters:            ±4kV AC						

**Electrical Fast Transient Burst Immunity Setup Photograph(s):**

## Electrical Fast Transient Burst Testing Overview

REV 18-MAR-04

High-voltage transients are developed on the power mains as a result of numerous types of switching actions. The interruption of current to inductive loads, relay contact bounce, and other actions may cause transients of several thousands of volts. These transients are characterized by very fast rise times and short pulse widths. They typically occur in bursts, with repetition rates as high as 100 kHz.

With the fast rise time associated with the transient, the energy content of the waveform extends to several hundred megahertz. With this high frequency content, the generated noise exists not only on the power lines, but also as noise coupled to the control and signal lines.

The basic measurement standard for these Electrical Fast Transient Bursts (EFT) is EN 61000-4-4. This standard specifies transients with a double exponential waveshape. The rise time of the pulse is 5 nS, and the pulse width is 50 nS. The transients are injected in 15 mS bursts with a repetition rate between individual pulses of 5 kHz. The period between each burst is 300 mS.

The test equipment necessary to generate the required bursts usually uses an energy storage capacitor and high voltage source to charge the capacitor. The capacitor is charged to a specified high voltage and discharged into a discharge shaping resistor. The interaction of the storage capacitor and the discharge resistor determine the fall time of the pulse. The rise time of the waveform depends on the inductance in the discharge path, and the capacitance to ground. The standard (EN 61000-4-4) specifies that the transient generator should have a source impedance of 50 Ohms and that signal characteristics should be measured with the generator loaded with a matched 50 Ohm impedance.

EN 61000-4-4 offers a choice between two different test set-ups. The first is for a "field test" which is performed in actual installed conditions. In the case of a stationary, floor-mounted EUT, a 1m x 1m reference ground plane is placed near the EUT and grounded to the protective earth at the electrical mains outlet. The plane must be a metallic sheet of at least 0.25mm thick if made of copper or aluminum, or 0.65mm thick if made of other metal. The transient generator is located on the ground plane and grounded directly to the plane. The transient output of the generator is connected by an unshielded wire through a 33 nF capacitor to each of the power supply terminals and the protective earth terminal.

For field tests on non-stationary equipment, the EUT is in a normal configuration, and no artificial ground plane is used. The transient is injected between each power supply terminal and the protective earth terminal at the mains outlet to which the EUT is connected.

"Type tests", which are performed in a laboratory, use a somewhat different set-up. Our tests are type tests unless otherwise noted.

During laboratory tests, all equipment whether floor standing or tabletop must be mounted on a ground plane. The ground plane is 2.5m x 3.5m and is made of galvanized sheet steel. It is connected to the green wire of protective earth of the facility.

In the case of floor standing equipment, the EUT is placed on the groundplane and insulated from it by a 10 cm support. The EUT is configured and operated in accordance with its normal installation procedures. Any conductive structures located near the EUT must be a minimum of 50 cm from it. All connections to earth ground, whether the "green wire safety



ground" or cable shields, etc., are made in accordance with manufacturer's specifications. No additional connections of the chassis or ground system to the ground plane are permitted.

For tabletop equipment, the EUT is mounted approximately 0.8m above the reference ground plane. This is accomplished by placing the device on a wooden table. The requirements for ground plane size and connection to the ground plane by the EUT are the same as floor standing equipment.

The EFT test voltages are applied to the EUT in three basic configurations. First, the injection is performed on power supply inputs through a coupling network. This network consists of a capacitor to inject the signal onto the power line, and a decoupling network to prevent the injected signals from being impressed on the AC mains supply. They are built into the test equipment. The test voltage is applied between each power line individually with respect to earth ground. For higher current applications, the transient is injected using a discrete 33 nF capacitor into the power lines.

The second configuration involves injection of the EFT bursts onto I/O circuits and communication lines. This injection requires the use of a capacitive coupling clamp. The appropriate I/O cables are placed inside the coupling clamp and the specified peak voltage is injected between the coupling clamp and ground plane. The coupling clamp is placed at a distance of 1m or less from the EUT. In cases where the I/O cables exceeds 1m in length, the excess length is coiled, with a 0.4m diameter, and placed 10 cm above the ground plane. In the case of an uninterruptible power source tested to the requirements of EN50091-2, all cabling including AC input and output cabling and communication lines is conditioned using this injection method.

The third injection point is the earth connection of the EUT. In general, this earth connection is the "green wire ground" connected via the power cable. In some cases, additional grounding points may be installed. In these cases, the transient voltage is injected through the coupling network into these ground terminals as well. The EFT is injected via a coupling network similar to the power line injection method.

EN 61000-4-4 specifies that the bursts are injected for a period of 1 minute or more each configuration and polarity. Longer times are used for equipment with longer cycle times in order to apply the bursts during all EUT states. Injection is usually performed first at lower levels and then increased incrementally to the specification level. This incremental method again is performed in order to increase the probability of detecting anomalies before any potential damage is suffered at the higher voltage levels.

In the case of any anomalies, the peak level of the transient voltage is recorded, as well as the nature of the anomaly and the injection point.

All testing is performed within the framework of a *laboratory* quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.



**SURGE IMMUNITY****Test Method:**

In accordance with EN 61000-4-5:2005.

**Results:**

TEST	RESULT	STANDARD	TEST LEVEL	COMMENTS
<b>AC Input Surge</b>	PASS	EN 61000-4-5	±2kV Common ±1kV Differential	Performance Criteria B
<b>AC Output Surge</b>	PASS	EN 61000-4-5	±2kV Common ±1kV Differential	Performance Criteria B
<b>DC Surge</b>	N/A	EN 61000-4-5	N/A	EUT is AC powered
<b>Telco Surge</b>	PASS	EN 61000-4-5	±1kV	Performance Criteria B



## Surge Immunity Data Table(s):

Table 16

SURGE DATA SHEET							
<b>Work Order:</b> K1310 <b>Date:</b> 04-Nov-10    05-Nov-10 <b>Engineer:</b> John Cushing    Andrew Chin <b>EUT:</b> Colt HV <b>Company:</b> APC							
<b>Client Present:</b> Yes							
<b>Testing Location:</b> Littleton Distribution Center, One Distribution Center Circle, #1 Littleton, MA 01460							
<b>Performance Criteria:</b> B							
<b>Maximum Test Parameters:</b>							
<i>Input and Output AC Power Ports</i>							
Open Circuit Waveshape:	1.2/50	Tr/Th $\mu$ s	<b>Repetition Rate:</b> 1 surge per minute				
Line-to-earth:	$\pm 2$ kV	(charge voltage)	<b>Reps/Polarity/Phase Angle:</b> 5 (maximum test level)				
Line-to-line:	$\pm 1$ kV	(charge voltage)	1 (lower test levels)				
<b>EUT Operating Voltage/Frequency:</b> 220Vac, 60Hz							
<b>Test Equipment Used:</b>							
<b>LISNs/Measurement Probes</b>	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Surge Current Probe	NA	CM-1-L	Ion Physics	NA	1276	I	5/6/2011
<b>Oscilloscopes and Probes</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
EMC 100MHz		TDS 220	Tektronix	C036986	1166	I	11/23/2010
<b>Surge Generators</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Red BestEMC-2		711-1100	Schaffner	200122-074SC	623	I	8/31/2011
Transient Waveform Monitor (Voltage Probe)		TWM-5	CDI	N/A	1533	II	1/4/2011
<b>Meteorological Meters</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4/6/2011
EMC5 Thermohygrometer		35519-044	Control Company	90823030	1497	II	3/20/2011
<b>Atmospheric Conditions:</b>							
<b>Temp:</b> 23.2°C		<b>Humidity:</b> 24%		<b>Pressure:</b> 1008mbar			
<b>Test Points:</b>							
<b>AC Input</b>	<b>Test Level</b>	<b>Pass/Fail</b>	<b>Phase Angle</b>	<b>Comment</b>			
Line - Neutral	$\pm 0.5$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Line - Neutral	$\pm 1$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Line - Ground	$\pm 0.5$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Line - Ground	$\pm 1$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Line - Ground	$\pm 2$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Neutral - Ground	$\pm 0.5$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Neutral - Ground	$\pm 1$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Neutral - Ground	$\pm 2$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			

Table 17

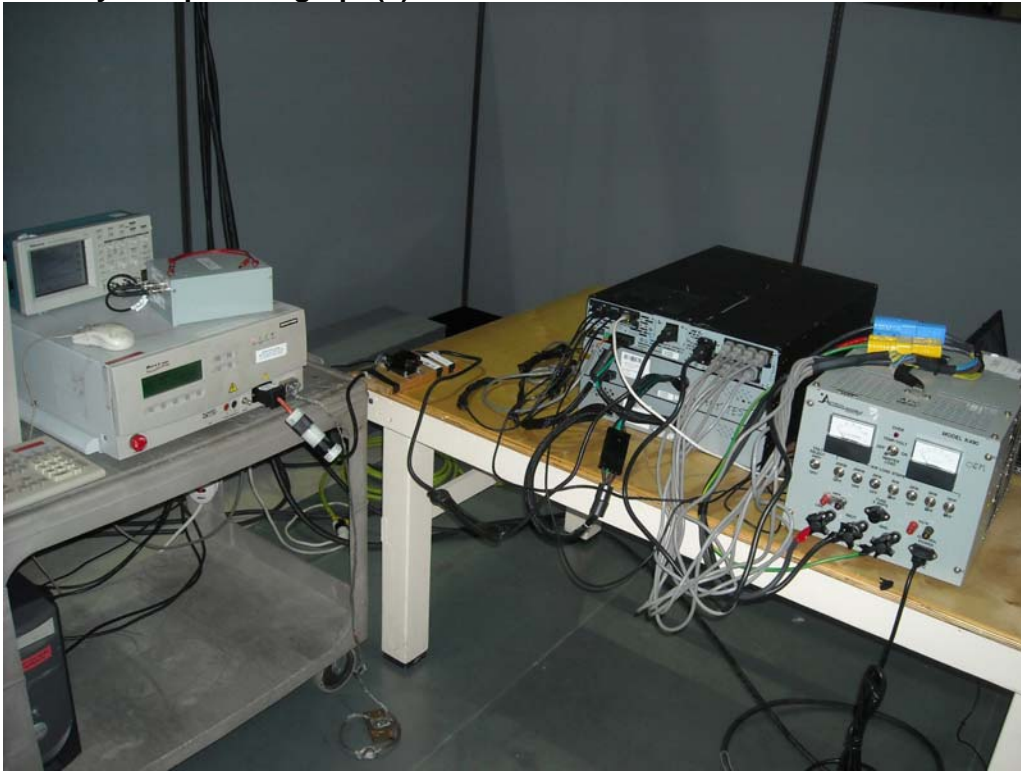
SURGE DATA SHEET							
<b>Work Order:</b> K1310 <b>Date:</b> 14-Feb-11 15-Feb-11 <b>Engineer:</b> Timothy Coughlin <b>EUT:</b> Colt HV <b>Company:</b> APC							
							<b>Client Present:</b> Yes
<b>Testing Location:</b> Littleton Distribution Center, One Distribution Center Circle, #1 Littleton, MA 01460							
<b>Performance Criteria:</b> B							
<b>Maximum Test Parameters:</b>							
<i>Input and Output AC Power Ports</i>							
Open Circuit Waveshape:		1.2/50	Tr/Th $\mu$ s	<b>Repetition Rate:</b> 1 surge per minute			
Line-to-earth:		$\pm 2$ kV	(charge voltage)	<b>Reps/Polarity/Phase Angle:</b> 5 (maximum test level)			
Line-to-line:		$\pm 1$ kV	(charge voltage)	1 (lower test levels)			
<b>EUT Operating Voltage/Frequency:</b> 220Vac, 60Hz							
<b>Test Equipment Used:</b>							
<b>LISNs/Measurement Probes</b>	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Surge Current Probe	NA	CM-1-L	Ion Physics	NA	1276	I	5/6/2011
<b>Oscilloscopes and Probes</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
EMC 100MHz		TDS 220	Tektronix	C036986	1166	I	1/4/2012
<b>Surge Generators</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Transient Waveform Monitor (Voltage Probe)		TWM-5	CDI	N/A	1533	II	1/4/2011
NSG 3060 Surge Generator		NSG 3060	Teseq	186	1329	I	1/6/2012
CDN 3063 3 Phase Coupling NWK		CDN 3063-S32	Teseq	81	1330	I	1/6/2012
<b>Meteorological Meters</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4/6/2011
EMC2 Thermohygrometer		35519-044	Control Company	72457653	1352	II	8/18/2011
<b>Atmospheric Conditions:</b>							
<b>Temp:</b> 22.8°C		<b>Humidity:</b> 23%		<b>Pressure:</b> 988mbar			
<b>Test Points:</b>							
<b>AC Input</b>	<b>Test Level</b>	<b>Pass/Fail</b>	<b>Phase Angle</b>	<b>Comment</b>			
Line - Neutral	$\pm 0.5$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Line - Neutral	$\pm 1$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Line - Ground	$\pm 0.5$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Line - Ground	$\pm 1$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Line - Ground	$\pm 2$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Neutral - Ground	$\pm 0.5$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Neutral - Ground	$\pm 1$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			
Neutral - Ground	$\pm 2$ kV	Pass	0°, 90°, 180°, 270°	AVR and Green Mode			

Table 18

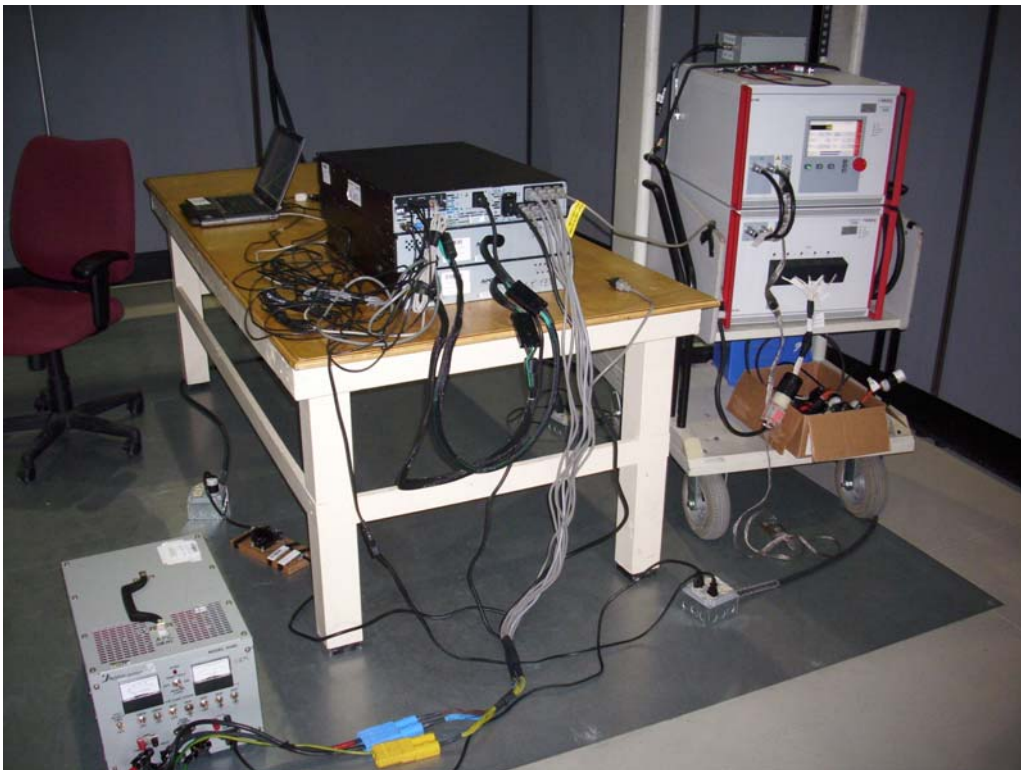
TELCO SURGE DATA SHEET																			
<b>Work Order:</b> K1310 <b>Date:</b> 08-Nov-10 <b>Engineer:</b> Andrew Chin <b>EUT:</b> Colt HV <b>Company:</b> APC																			
							<b>Client Present:</b> Yes												
<b>Testing Location:</b> Littleton Distribution Center, One Distribution Center Circle, #1 Littleton, MA 01460																			
<b>Performance Criteria:</b> B																			
<b>Maximum Test Parameters:</b> <table border="0"> <thead> <tr> <th></th> <th>Indoor Signal/Telco Lines</th> <th>Outdoor Signal/Telco Lines</th> <th></th> </tr> </thead> <tbody> <tr> <td>Open Circuit Waveshape:</td> <td>1.2/50</td> <td>1.2/50</td> <td>Tr/Th <math>\mu</math>s</td> </tr> <tr> <td>Signal and Telco Ports:</td> <td>N/A</td> <td><math>\pm 1</math>kV</td> <td>(charge voltage)</td> </tr> </tbody> </table>									Indoor Signal/Telco Lines	Outdoor Signal/Telco Lines		Open Circuit Waveshape:	1.2/50	1.2/50	Tr/Th $\mu$ s	Signal and Telco Ports:	N/A	$\pm 1$ kV	(charge voltage)
	Indoor Signal/Telco Lines	Outdoor Signal/Telco Lines																	
Open Circuit Waveshape:	1.2/50	1.2/50	Tr/Th $\mu$ s																
Signal and Telco Ports:	N/A	$\pm 1$ kV	(charge voltage)																
<b>EUT Operating Voltage/Frequency:</b> 220Vac, 60Hz																			
<b>Test Equipment Used:</b>																			
<b>LISNs/Measurement Probes</b>	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>												
Surge Current Probe	NA	CM-1-L	Ion Physics	NA	1276	I	5/6/2011												
<b>Oscilloscopes and Probes</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>												
EMC 100MHz		TDS 220	Tektronix	C036986	1166	I	11/23/2010												
<b>Surge Generators</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>												
NSG 3060 Surge Generator		NSG 3060	Teseq	186	1329	I	2/11/2011												
CDN 3063 3 Phase Coupling NWK		CDN 3063-S32	Teseq	81	1330	I	2/11/2011												
<b>Meteorological Meters</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>												
Weather Clock (Pressure Only)		BA928	Oregon Scientific	C3166-1	831	I	3/17/2011												
EMC5 Thermohygrometer		35519-044	Control Company	90823030	1497	II	3/20/2011												
<b>Atmospheric Conditions:</b>																			
<b>Temp:</b> 22.6°C		<b>Humidity:</b> 26%		<b>Pressure:</b> 992mbar															
<b>Test Points:</b>	<b>Test Voltage</b>	<b>Pass/Fail/NA</b>	<b>Comments</b>																
USB	N/A	NA	indoor cable																
Ethernet	$\pm 1$ kV	Pass																	
Universal I/O	N/A	NA	indoor cable																
EPO	N/A	NA	indoor cable																
USB (2)	N/A	NA	indoor cable																
Serial	N/A	NA	indoor cable																
Console	N/A	NA	indoor cable																
120VDC	N/A	NA	indoor cable																

**Modifications in place during testing:**See *Modifications Required for Compliance* section.

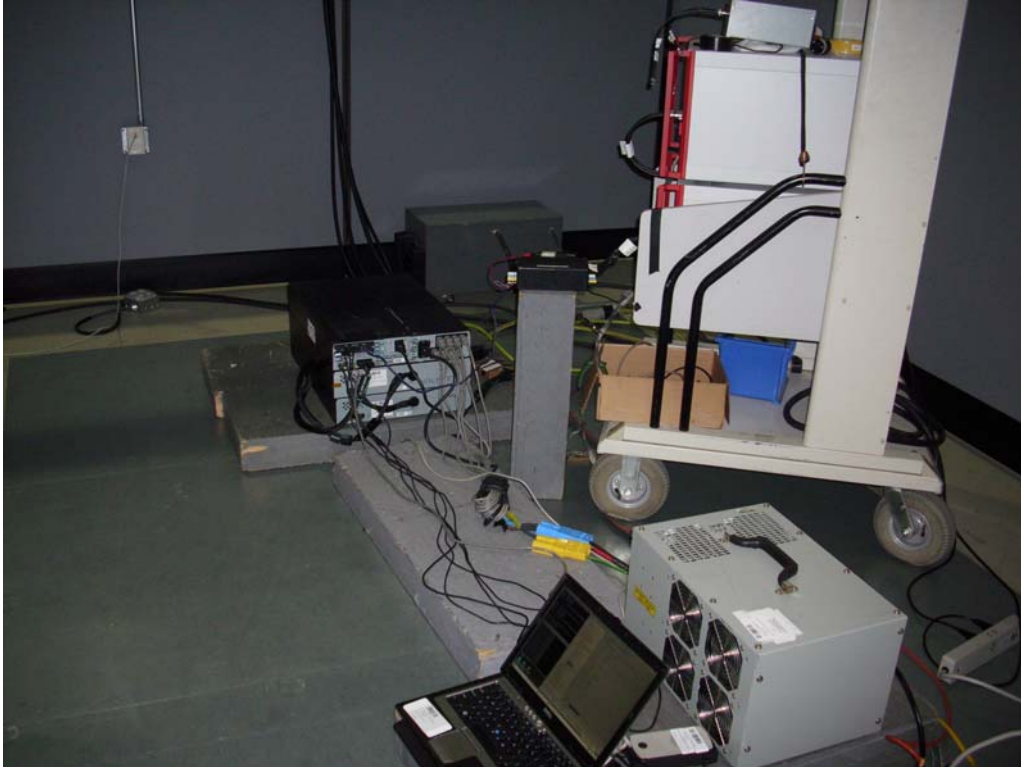
**Surge Immunity Setup Photograph(s):**



**AC Input Surge**



**AC Output Surge**



Signal Surge

## Power Line Lightning Transient Testing

REV 17-FEB-04

Power lines are subjected to surges which result primarily from lightning events. Typical lightning waveforms, are specified in EN 61000-4-5. The transients specified are double exponential waveforms with a rise time of 1.2  $\mu$ S and a pulse width of 50  $\mu$ S (open circuit). The short circuit waveform is an 8 x 20  $\mu$ S double exponential. The usual level for longitudinal common mode injection AC power ports is 2 kV open circuit with a short circuit current of 1 kA. In the differential mode (between phase and neutral) the peak level is limited to 1 kV. The surges are injected in both positive and negative polarities into the AC line at phase angles between 0 and 360°. A CDI M5 Universal Surge Generator™ is used to generate the appropriate waveshapes and amplitudes.

For the EN 61000-4-5 test method, 5 repetitions are applied in each polarity and at the 0, 90, 180, and 270 points of the AC cycle. Surges are applied from each line to ground using a 12 Ohm source impedance and from each line to every other line combination (including neutral) using a 2 Ohm source impedance. DC power ports and some signal lines are also subjected to 1.2 x 50  $\mu$ S lightning surges. In this case, however, the peak voltage is usually limited to 500 volts in both common and differential mode.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.



**CONDUCTED RADIO FREQUENCY IMMUNITY****Test Method:**

In accordance with EN 61000-4-6:2007.

**Results:**

TEST	RESULT	STANDARD	TEST LEVEL	COMMENTS
<b>CRFI</b>	PASS	EN 61000-4-6	10V, 0.15-80 MHz, 1kHz 80% AM	Performance Criteria A



## Conducted RF Immunity Data Table(s):

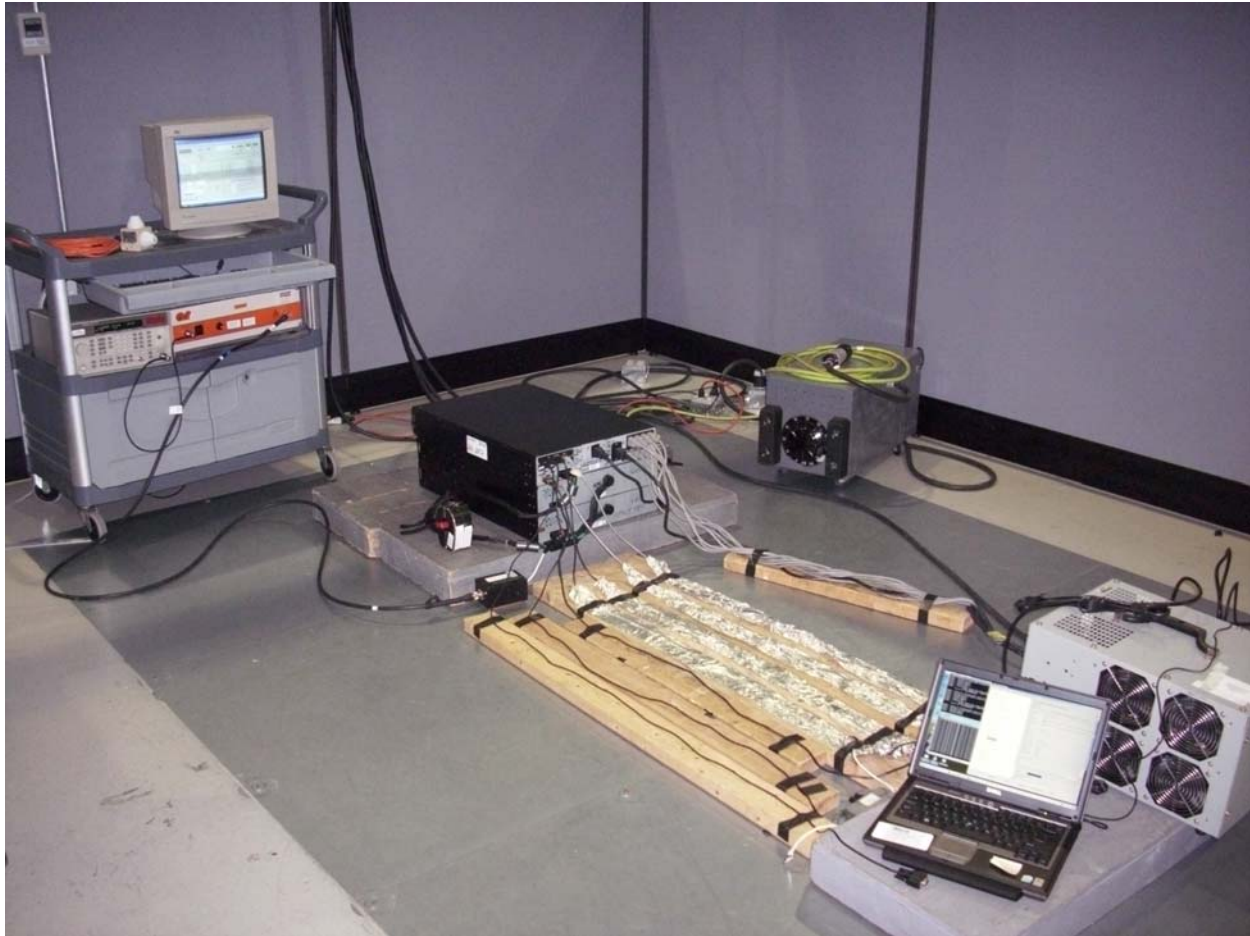
Table 19

CRFI DATA SHEET							
<b>Work Order:</b> K1310 <b>Date:</b> 06-Oct-10    07-Oct-10    08-Oct-10    05-Nov-10 <b>Engineer:</b> Andrew Chin <b>EUT:</b> Colt HV <b>Company:</b> APC							
							<b>Client Present:</b> Yes
<b>Testing Location:</b> Littleton Distribution Center, One Distribution Center Circle, #1 Littleton, MA 01460							
<b>Performance Criteria:</b> A <b>EUT Cycle Time:</b> Continuous <b>Frequency Range:</b> 0.15-80MHz <b>EUT Operating Voltage/Frequency:</b> 220Vac, 60Hz <b>Signal Level:</b> 10Vrms <b>Dwell Frequencies:</b> 0.2, 1.0, 7.1, 13.56, 21, 27.12, 40.68MHz <b>Modulation:</b> 80% AM @ 1kHz sine <b>Clock Frequencies:</b> 8, 20, 25, 48MHz							
<b>Test Equipment Used:</b>							
<b>CRFI Systems</b>	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>ASSET</b>	<b>Cat</b>	<b>Calibration Due</b>
Orange Amp - Green Resistor	0.10 - 100MHz						5/27/2011
Orange Amp	0.01-100MHz	75A250	AR	26827	367	II	
Green Resistor	0.10-100MHz	100W Resistor	C-S		1172	II	
Orange Amp - Red Clamp - EU	0.10 - 100MHz						5/27/2011
Orange Amp	0.01-100MHz	75A250	AR	26827	367	II	
Red Clamp	0.01-100MHz	95236-1	ETS	34026	1020	II	
Black Amp - Brown CDN	0.10 - 100MHz						6/1/2011
Black Amp	0.01-100MHz	75A250	AR	23411	122	II	
Brown CDN	0.10-100MHz	M-3	C-S		1169	II	
<b>Signal Generators</b>	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Red	0.09-2000MHz	HP8648B	Agilent	3847U02192	366	I	6/29/2011
Orange	0.1-1000MHz	HP8648B	Agilent	3537A01210	25	I	7/23/2011
<b>Meteorological Meters</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Weather Clock (Pressure Only)		BA928	Oregon Scientific	C3166-1	831	I	3/17/2011
EMC2 Thermohygrometer		35519-044	Control Company	72457653	1352	II	8/18/2011
EMC5 Thermohygrometer		35519-044	Control Company	90823030	1497	II	3/20/2011
<b>Cables</b>	<b>Range</b>		<b>Mfr</b>			<b>Cat</b>	<b>Calibration Due</b>
CRFI-RFI-04	9kHz - 2GHz		C-S			II	4/6/2011
CRFI-RFI-BNC-11	9kHz - 2GHz		C-S			II	1/4/2011
<b>Atmospheric Conditions:</b>							
<b>Temp:</b> 21.0°C		<b>Humidity:</b> 47%		<b>Pressure:</b> 1011mbar			
<b>Temp:</b> 23.4°C		<b>Humidity:</b> 41%		<b>Pressure:</b> 993mbar			
<b>Test Points:</b>							
AC Input	Pass/Fail/NA		Comments:				
AC Output (20A)	Pass		AVR and Green Mode				
AC Output (30A)	Pass						
USB	Pass						
Ethernet	Pass						
Universal I/O	Pass						
EPO	Pass						
USB (2)	Pass						
Serial	Pass						
Console	Pass						
120VDC	N/A		<3m				

## Modifications in place during testing:

See Modifications Required for Compliance section.



**Conducted RF Immunity Setup Photograph(s):**

## Conducted RF Immunity Testing Overview

REV 17-FEB-04

At lower frequencies it is difficult to design a radiating test source to simulate the coupling that occurs in the real world due to radiated fields. For all testing below 26MHz and occasionally for testing as high as 230MHz, Conducted RF (sometimes called “bulk current injection”) is utilized to simulate radiated field disturbances.

Radiated fields result from many sources. In today's environment the RF spectrum is crowded by broadcast media (radio and TV), cellular phone systems, telemetry, amateur radio, radio navigation aids, industrial scientific and medical (ISM) devices, and others, all of which have the potential to disturb electronic products.

Development of test standards is based on statistical analysis of various RF sources within these allocations. In some rare cases, electrical field levels can reach hundreds of volts per meter (e.g. - an installation close to a high power broadcast transmitter). At other, remote locations, fields are usually less than 1 V/m. Modulation types and levels also vary from site to site. For stimulation from a 150 Ohm RF source, EN 61000-4-6 has set a level of 1 V open circuit as equivalent to 1 V/m.

The EUT is configured on a 0.1 meter high non-conductive platform over a ground plane which extends at least 0.5 meters beyond the edge of the EUT. All vertical conducting surfaces are at a distance of at least 0.5 meters. Where possible, each cable leaving the EUT is terminated in an equivalent 150 Ohm common mode load. The purpose of the test is to have RF current flow through the EUT as if it was the center of a dipole made from it and its cables. Thus one cable is stimulated at a time with a 150 Ohm RF source and the current flows to the EUT and out to the cables which are passively terminated to the ground plane in 150 Ohm common mode loads. For shielded (screened) cables, the shield is the injection point. For unshielded cables either a decoupling network with a total parallel impedance of 150 Ohms or a bulk current injection clamp is utilized to inject the disturbance. For the AC mains, a decoupling network with 150 Ohm parallel RF impedance is used.

The signal generator and amplifier are adjusted by a computer using predetermined signal levels derived during a calibration routine. During calibration, a 150 Ohm load is driven by the signal generator and the coupling network or clamp being calibrated. Signal levels at specific frequencies required to produce the desired stimulation level are recorded. The stimulation level desired is one-half that the open circuit voltage as the 150 Ohm source is loaded with 150 Ohms. If a bulk current probe is used, a second measurement current probe is inserted over the cable and the signal level is reduced if the current exceeds that which would be injected into a 150 Ohm load.

For complex EUT's, not all possible conduction paths are explored. In accordance with EN 61000-4-6,  $n$  paths are evaluated, where  $2 \leq n \leq 5$ . This is assumed to adequately stimulate the EUT and expose failures. The paths are picked based on an evaluation of the EUT architecture and are expected to be the most vulnerable to the conducted disturbances. The test report will detail the paths selected for stimulation.

In the event of an operating anomaly, the frequency and the nature of the anomaly is recorded. The signal strength is reduced until the normal operation is restored. The equivalent open circuit voltage is recorded as the threshold of susceptibility. After the device is characterized



in the required environment, modifications are made to the EUT to improve immunity as appropriate. In some cases, the EUT is extremely sensitive at several frequencies. In these instances, characterization testing may be terminated early to preclude damage.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.



**MAGNETIC FIELD IMMUNITY****Test Method:**

In accordance with EN 61000-4-8:2001.

**Results:**

TEST	RESULT	STANDARD	TEST LEVEL	COMMENTS
<i>Power-Frequency Magnetic Field</i>	PASS	EN 61000-4-8	30A/m	Performance Criteria A

**Power Frequency Magnetic Field Immunity Data Table(s):**

Power-Frequency Magnetic Field							
<b>Work Order:</b> K1310 <b>Date:</b> 15-Feb-11 <b>Engineer:</b> Disha Vachhani <b>EUT:</b> Colt HV <b>Company:</b> APC							
<b>Client Present:</b> Yes							
<b>Testing Location:</b> Littleton Distribution Center, One Distribution Center Circle, #1 Littleton, MA 01460							
<b>Performance Criteria:</b> A <b>Maximum Test Parameters:</b> 30A/m <b>Frequency:</b> 50Hz/60Hz							
<b>EUT Operating Voltage/Frequency:</b> 230Vac, 50Hz and 208Vac, 60Hz							
<b>Test Equipment Used:</b>							
<b>Field Probes</b>	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Gaussmeter (ELF Meter)	25Hz-1kHz	4080	Sypris	114173	1305	I	6/23/2012
<b>Antennas</b>	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Induction Coil	50-60Hz	1000-4-8	C-S	N/A	1314	II	6/9/2011
<b>Amplifiers</b>	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Audio Amp	Audio Freq	MPA-200	Radio Shack	708545	862	III	NA
<b>Signal Generators</b>	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Brown-White	0.01Hz-15MHz	HP33120A	Agilent	SG40019842	1232	I	1/22/2011
<b>RMS Voltmeters/Current Clamp</b>		<b>MN</b>	<b>Mnfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
DMM		388B	BK Precision	4060166	1010	I	11/20/2011
<b>Meteorological Meters</b>		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Weather Clock (Pressure Only)		BA928	Oregon Scientific	C3166-1	831	I	3/17/2011
EMC2 Thermohygrometer		35519-044	Control Company	72457653	1352	II	8/18/2011
<b>Atmospheric Conditions:</b>							
<b>Temp:</b> 22.1°C		<b>Humidity:</b> 22%		<b>Pressure:</b> 1012mbar			
<b>Orthogonal Axes Tested:</b>							
<b>X</b>	<b>Y</b>	<b>Z</b>					
Pass	Pass	Pass	Pass/Fail				
<b>Note:</b> Tested in AVR and Green modes							

**Modifications in place during testing:**See *Modifications Required for Compliance* section.



**Power Frequency Magnetic Field Immunity Setup Photograph(s):**



## Power Frequency Magnetic Field Immunity Testing Overview

REV 17-FEB-04

Magnetic Fields created by power distribution at 50 or 60 Hz can interfere with normal equipment operation. Particularly sensitive are devices which use electron beams, such as monitors. Typical manifestations of interference are the wavy images on a computer monitor screen. Only devices with known sensitivity to magnetic fields such as monitors and devices incorporating hall effect sensors are tested.

Usually, equipment is tested only for its immunity to continuous steady magnetic fields, although occasionally, test plans call for evaluation to brief peak levels such that might be observed in a substation during fault clearing.

Equipment is tested by placing it within the uniform area (to 3dB) of a magnetic loop and observing its behavior while a current known to produce a specific magnetic field level is run through the loop. The current is run at the nominal power frequency of 50Hz for equipment destined for Europe.

EN 61000-4-8 is the basic procedure for power frequency magnetic immunity testing. Typically one of two loops is used. For table top equipment less than 0.6 meters on a side (excluding cables), a 10-turn 1 meter square loop is used to produce the field. Current is supplied from an audio amplifier through a 5 Ohm resistor. The voltage is monitored across the resistor with an oscilloscope and the drive level is adjusted until the desired current through the resistor (and therefore the loop) is achieved. Calibration is performed using a Tibitts coil as the measuring pickup. For floor standing equipment, the equipment is placed within a floor-standing loop which measures 1.5x2 meters. Occasionally other loops may be used and these are noted in the test report.

Equipment is tested with stimulation in three orthogonal axes wherever possible. Deviations are noted in the test report.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.



**VOLTAGE DIPS AND INTERRUPTS IMMUNITY****Test Method:**

In accordance with EN 61000-4-11:2004.

**Results:**

TEST	RESULT	STANDARD	TEST LEVEL	COMMENTS
<i>Voltage Dips and Short Interruptions</i>	PASS	EN 61000-4-11	<5%V for 0.5 and 1 cycle	Performance Criteria B
			70%V for 30 cycles	Performance Criteria C
	PASS	EN 61000-4-11	<5%V for 300 cycles	Performance Criteria C

**Mains Supply Voltage Dips, Short Interrupts and Variations Data Table(s):****Table 20**

VOLTAGE DIPS AND INTERRUPTS DATA SHEET						
<div>Work Order: K1310</div> <div>Date: 08-Nov-10</div> <div>Engineer: Andrew Chin</div> <div>EUT: Colt HV</div> <div>Company: APC</div> <div>Client Present: Yes</div>						
Testing Location: Littleton Distribution Center, One Distribution Center Circle, #1 Littleton, MA 01460						
Maximum Test Parameters: 100% Voltage Reduction 5.0 Seconds						
Test Equipment Used:						
Dips and Interrupts	MN	Mfr	SN	Asset	Cat	Calibration Due
Modula6150	Modula6150	Teseq	34525	1268	I	11/17/2010
Meteorological Meters	MN	Mfr	SN	Asset	Cat	Calibration Due
Weather Clock (Pressure Only)	BA928	Oregon Scientific	C3166-1	831	I	3/17/2011
EMC5 Thermohygrometer	35519-044	Control Company	90823030	1497	II	3/20/2011
Atmospheric Conditions:						
Temp: 22.6°C		Humidity: 26%		Pressure: 992mbar		
EUT Low Voltage: 140Vac, 60Hz Zero Load						
%V	Duration	Result	Criteria	Comment		
0%	0.5 cycle	Pass	B	90° and 270°		
0%	1 cycle	Pass	B			
70%	30 cycles	Pass	B			
0%	300 cycles	Pass	C			
EUT Low Voltage: 167Vac, 60Hz 2.25kW Load						
%V	Duration	Result	Criteria	Comment		
0%	0.5 cycle	Pass	B	90° and 270°		
0%	1 cycle	Pass	B			
70%	30 cycles	Pass	B			
0%	300 cycles	Pass	C			
EUT High Voltage: 250Vac, 60Hz 2.25kW load						
%V	Duration	Result	Criteria	Comment		
0%	0.5 cycle	Pass	B	90° and 270°		
0%	1 cycle	Pass	B			
70%	30 cycles	Pass	B			
0%	300 cycles	Pass	C			

**Modifications in place during testing:**See *Modifications Required for Compliance* section.

**Mains Supply Voltage Dips, Short Interrupts and Variations Setup Photograph(s):**



## Mains Supply Voltage Dips, Short Interrupts and Variations

REV 17-FEB-04

A device connected to an a.c. mains distribution network will often experience changes, abrupt or gradual, in the voltage level seen on the line due to activity on the network. This includes reductions, interruptions and variations in voltage associated with load switching and operation of protection devices.

A voltage dip is a sudden reduction of the supply voltage at a particular node in the distribution network which is followed by voltage recovery after a short period of time (0.5 cycles to a few seconds). A short interrupt is the disappearance of this supply voltage for a period of time (usually less than 1 minute); it is a voltage dip with 100% (>95%) amplitude. If the change to the supply voltage is gradual, it is considered a voltage variation. A voltage variation can be higher or lower than the rated voltage, and the duration of change can be short or long with regard to the period. These phenomena are often random and can be characterized in terms of duration and deviation from the rated voltage.

Rotating machines and protection elements connected to the mains network help dictate the behavior the network exhibits when large portions of the network are disconnected (local within a plant or wide area within a region). When the disconnection occurs, the slow reaction time of many rotating machines forces a gradual reduction in voltage; for a short period, these machines will actually operate as generators, sending power into the network.

Some equipment is more sensitive to gradual variations in voltage than to abrupt change. Most data processing equipment, for instance, have built in power fail detectors in order to protect and save the data properly; these detectors will often not react fast enough to a gradual decrease in mains voltage. The DC voltage to the integrated circuits may decrease to a level below the minimum operating voltage before the detector is activated and results in lost or distorted data, generally making necessary the re-programming of the data processing equipment.

We use the international standard EN 61000-4-11 which outlines the procedure and apparatus used to demonstrate the immunity of equipment to the reductions, interruptions and variations in voltage supplied by an a.c. mains distribution network. The test is performed with the EUT connected to the test generator as described in EN 61000-4-11. EN 61000-4-11 offers the preferred test levels and duration times of conditioning, although whenever possible a specific product standard should be consulted for these values. The EUT is tested for each selected combination of test level and duration with a sequence of 3 dips/interruptions with intervals of at least 10 seconds between each event. Each representative mode of operation is tested. The equipment is considered immune if, during and after the conditioning, it is able to fulfill the functional requirements established by the specific product standard.

For voltage variations we expose the equipment to each of the maximum (e.g. nominal supply voltage + 10%) and minimum (e.g. nominal supply voltage – 15%) power supply conditions for a sufficient time to obtain temperature stability. Where provision is made to adapt the equipment to suit a number of nominal supply voltages such as with a transformer tap change, the maximum and minimum values are tested for each value. For equipment which is claimed to be suitable for a range of nominal mains voltages (e.g. 120/240 V) without user intervention, the minimum condition is applied to the lower end of the range, while the maximum





condition is applied to the larger value in the range. The equipment is considered immune if, during the conditioning, it is able to fulfill the functional requirements established by the specific product standard.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.



**HARMONIC EMISSIONS AND VOLTAGE FLUCTUATIONS/FLICKER****Test Method:**

In accordance with EN 61000-3-2:2006 and EN 61000-3-3:1995/A1:2001/A2:2005.

**Results:**

TEST	RESULT	STANDARD	EQUIPMENT TYPE	COMMENTS
<i>Harmonics</i>	PASS	EN 61000-3-2	Class A	
<i>Flicker</i>	PASS	EN 61000-3-3		

**Harmonic Emissions and Voltage Fluctuations/Flicker Data Table(s):****Table 21****Harmonics – Class-A per Ed. 3.0 (2006)(Run time)**

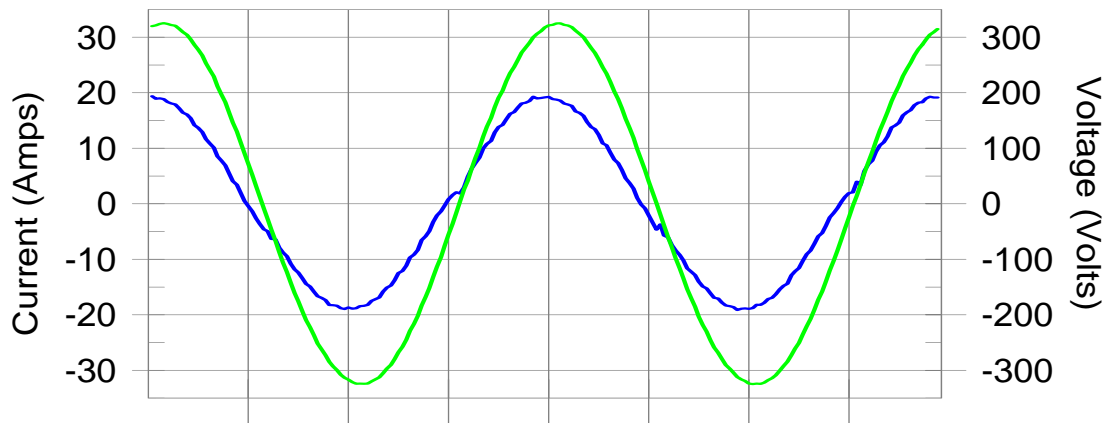
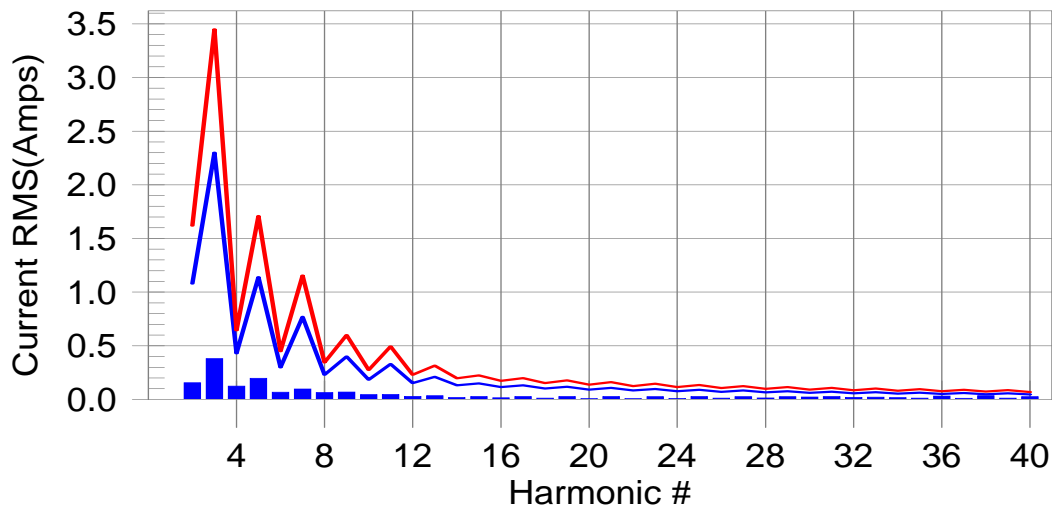
EUT: SMX3000RMHV2UNC – AVR mode  
 Test category: Class-A per Ed. 3.0 (2006) (European limits)  
 Test date: 11/4/2010 Start time: 8:36:11 AM End time: 8:46:31 AM  
 Test duration (min): 10 Data file name: H-001514.cts\_data  
 Comment: Equipment: California Instruments 5001ix Site: EMC5 Temp: 22.6°C Humidity: 24% Pressure: 1008mbar  
 Customer: APC

Tested by: John Cushing

Test Margin: 100

End time: 8:46:31 AM

Test Result: Pass Source qualification: Normal

Current & voltage waveformsHarmonics and Class A limit lineEuropean Limits**Test result: Pass Worst harmonic was #38 with 69.37% of the limit.**

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**Current Test Result Summary (Run time)**

EUT: SMX3000RMHV2UNC – AVR mode      Tested by: John Cushing  
 Test category: Class-A per Ed. 3.0 (2006) (European limits)      Test Margin: 100  
 Test date: 11/4/2010      Start time: 8:36:11 AM      End time: 8:46:31 AM  
 Test duration (min): 10      Data file name: H-001514.cts\_data  
 Comment: Equipment: California Instruments 5001ix      Site: EMC5 Temp: 22.6°C Humidity: 24% Pressure: 1008mbar  
 Customer: APC

Test Result: Pass      Source qualification: Normal  
 THC(A): 0.51      I-THD(%): 3.88      POHC(A): 0.069      POHC Limit(A): 0.251  
 Highest parameter values during test:

V_RMS (Volts):	229.71	Frequency(Hz):	50.00
I_Peak (Amps):	19.692	I_RMS (Amps):	13.265
I_Fund (Amps):	13.225	Crest Factor:	1.494
Power (Watts):	2979.8	Power Factor:	0.980

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.154	1.080	14.2	0.156	1.620	9.65	Pass
3	0.379	2.300	16.5	0.380	3.450	11.02	Pass
4	0.124	0.430	28.8	0.125	0.645	19.39	Pass
5	0.196	1.140	17.2	0.197	1.710	11.51	Pass
6	0.066	0.300	22.0	0.068	0.450	15.09	Pass
7	0.097	0.770	12.6	0.099	1.155	8.53	Pass
8	0.064	0.230	27.8	0.065	0.345	18.83	Pass
9	0.068	0.400	17.0	0.069	0.600	11.54	Pass
10	0.044	0.184	23.8	0.045	0.276	16.30	Pass
11	0.046	0.330	13.9	0.047	0.495	9.47	Pass
12	0.027	0.153	17.7	0.029	0.230	12.59	Pass
13	0.034	0.210	16.0	0.035	0.315	11.00	Pass
14	0.018	0.131	14.0	0.019	0.197	9.68	Pass
15	0.027	0.150	18.0	0.028	0.225	12.42	Pass
16	0.014	0.115	12.1	0.015	0.173	8.67	Pass
17	0.027	0.132	20.1	0.027	0.199	13.77	Pass
18	0.011	0.102	10.8	0.012	0.153	7.96	Pass
19	0.026	0.118	22.0	0.027	0.178	15.23	Pass
20	0.006	0.092	7.0	0.009	0.138	6.53	Pass
21	0.026	0.107	24.5	0.027	0.161	16.80	Pass
22	0.008	0.084	9.7	0.009	0.125	7.19	Pass
23	0.026	0.098	26.4	0.027	0.147	18.15	Pass
24	0.009	0.077	11.3	0.010	0.115	8.42	Pass
25	0.027	0.090	29.5	0.028	0.135	20.37	Pass
26	0.011	0.071	14.9	0.012	0.106	11.16	Pass
27	0.026	0.083	30.7	0.027	0.125	21.31	Pass
28	0.013	0.066	19.1	0.014	0.099	14.01	Pass
29	0.025	0.078	32.8	0.027	0.116	22.87	Pass
30	0.022	0.061	35.4	0.023	0.092	25.03	Pass
31	0.026	0.073	36.4	0.028	0.109	25.51	Pass
32	0.019	0.058	32.3	0.020	0.086	22.94	Pass
33	0.019	0.068	28.4	0.021	0.102	20.49	Pass
34	0.016	0.054	28.7	0.017	0.081	20.69	Pass
35	0.012	0.064	17.9	0.013	0.096	13.73	Pass
36	0.031	0.051	60.7	0.033	0.077	42.62	Pass
37	0.009	0.061	15.4	0.011	0.091	11.59	Pass
38	0.034	0.048	69.4	0.035	0.073	47.80	Pass
39	0.012	0.058	20.1	0.013	0.087	14.59	Pass
40	0.022	0.046	47.5	0.026	0.069	38.18	Pass



**Voltage Source Verification Data (Run time)**

EUT: SMX3000RMHV2UNC – AVR mode      Tested by: John Cushing  
 Test category: Class-A per Ed. 3.0 (2006) (European limits)      Test Margin: 100  
 Test date: 11/4/2010      Start time: 8:36:11 AM      End time: 8:46:31 AM  
 Test duration (min): 10      Data file name: H-001514.cts\_data  
 Comment: Equipment: California Instruments 5001ix      Site: EMC5 Temp: 22.6°C Humidity:  
 24% Pressure: 1008mbar  
 Customer: APC

Test Result: Pass      Source qualification: Normal

**Highest parameter values during test:**

Voltage (Vrms):	229.71	Frequency(Hz):	50.00
I_Peak (Amps):	19.692	I_RMS (Amps):	13.265
I_Fund (Amps):	13.225	Crest Factor:	1.494
Power (Watts):	2979.8	Power Factor:	0.980

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.077	0.459	16.80	OK
3	0.385	2.067	18.61	OK
4	0.054	0.459	11.69	OK
5	0.051	0.919	5.59	OK
6	0.026	0.459	5.76	OK
7	0.084	0.689	12.17	OK
8	0.037	0.459	8.13	OK
9	0.067	0.459	14.58	OK
10	0.053	0.459	11.62	OK
11	0.031	0.230	13.37	OK
12	0.016	0.230	6.97	OK
13	0.020	0.230	8.90	OK
14	0.014	0.230	6.20	OK
15	0.024	0.230	10.36	OK
16	0.029	0.230	12.81	OK
17	0.023	0.230	9.83	OK
18	0.037	0.230	16.01	OK
19	0.020	0.230	8.85	OK
20	0.016	0.230	7.04	OK
21	0.022	0.230	9.58	OK
22	0.012	0.230	5.01	OK
23	0.020	0.230	8.77	OK
24	0.007	0.230	3.07	OK
25	0.024	0.230	10.55	OK
26	0.014	0.230	6.11	OK
27	0.020	0.230	8.58	OK
28	0.011	0.230	4.91	OK
29	0.027	0.230	11.91	OK
30	0.035	0.230	15.24	OK
31	0.049	0.230	21.44	OK
32	0.022	0.230	9.55	OK
33	0.029	0.230	12.44	OK
34	0.023	0.230	10.19	OK
35	0.006	0.230	2.70	OK
36	0.046	0.230	20.18	OK
37	0.010	0.230	4.31	OK
38	0.048	0.230	21.07	OK
39	0.016	0.230	6.76	OK
40	0.042	0.230	18.08	OK



Table 22

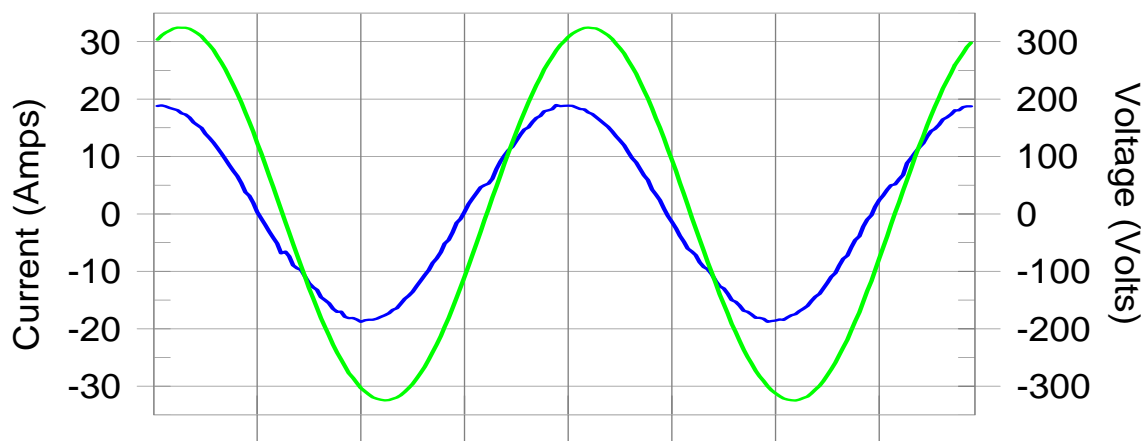
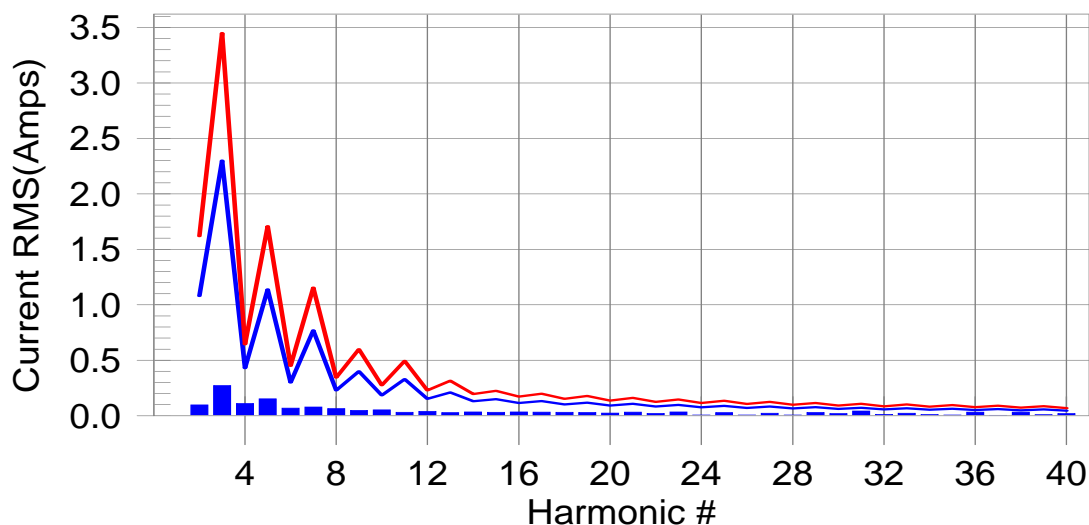
**Harmonics – Class-A per Ed. 3.0 (2006)(Run time)**

EUT: SMX3000RMHV2UNC – Green mode  
 Test category: Class-A per Ed. 3.0 (2006) (European limits)  
 Test date: 11/4/2010 Start time: 8:52:45 AM End time: 9:03:05 AM  
 Test duration (min): 10 Data file name: H-001515.cts\_data  
 Comment: Equipment: California Instruments 5001ix Site: EMC5 Temp: 22.6°C Humidity: 24% Pressure: 1008mbar  
 Customer: APC

Tested by: John Cushing

Test Margin: 100

Test Result: Pass Source qualification: Normal

**Current & voltage waveforms****Harmonics and Class A limit line****European Limits****Test result: Pass Worst harmonic was #38 with 62.91% of the limit.**



## Current Test Result Summary (Run time)

EUT: SMX3000RMHV2UNC – Green mode Tested by: John Cushing  
 Test category: Class-A per Ed. 3.0 (2006) (European limits) Test Margin: 100  
 Test date: 11/4/2010 Start time: 8:52:45 AM End time: 9:03:05 AM  
 Test duration (min): 10 Data file name: H-001515.cts\_data  
 Comment: Equipment: California Instruments 5001ix Site: EMC5 Temp: 22.6°C Humidity:  
 24% Pressure: 1008mbar  
 Customer: APC

Test Result: Pass Source qualification: Normal  
 THC(A): 0.40 I-THD(%): 3.03 POHC(A): 0.093 POHC Limit(A): 0.251  
 Highest parameter values during test:

V\_RMS (Volts): 229.78 Frequency(Hz): 50.00  
 I\_Peak (Amps): 19.240 I\_RMS (Amps): 13.107  
 I\_Fund (Amps): 13.136 Crest Factor: 1.476  
 Power (Watts): 2839.4 Power Factor: 0.945

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.096	1.080	8.9	0.098	1.620	6.05	Pass
3	0.270	2.300	11.8	0.272	3.450	7.89	Pass
4	0.110	0.430	25.6	0.111	0.645	17.28	Pass
5	0.151	1.140	13.2	0.152	1.710	8.90	Pass
6	0.067	0.300	22.3	0.069	0.450	15.24	Pass
7	0.078	0.770	10.1	0.079	1.155	6.85	Pass
8	0.064	0.230	27.8	0.065	0.345	18.75	Pass
9	0.048	0.400	12.0	0.049	0.600	8.12	Pass
10	0.053	0.184	28.6	0.054	0.276	19.44	Pass
11	0.031	0.330	9.4	0.032	0.495	6.48	Pass
12	0.040	0.153	26.1	0.041	0.230	18.03	Pass
13	0.028	0.210	13.4	0.029	0.315	9.21	Pass
14	0.034	0.131	25.8	0.035	0.197	17.67	Pass
15	0.030	0.150	20.2	0.031	0.225	13.88	Pass
16	0.034	0.115	29.2	0.035	0.173	20.00	Pass
17	0.033	0.132	24.8	0.033	0.199	16.82	Pass
18	0.030	0.102	29.7	0.032	0.153	20.78	Pass
19	0.029	0.118	24.3	0.030	0.178	16.70	Pass
20	0.020	0.092	21.4	0.024	0.138	17.68	Pass
21	0.032	0.107	30.1	0.033	0.161	20.62	Pass
22	0.020	0.084	24.0	0.021	0.125	16.93	Pass
23	0.033	0.098	34.2	0.034	0.147	23.38	Pass
24	0.007	0.077	9.2	0.008	0.115	7.05	Pass
25	0.028	0.090	31.1	0.029	0.135	21.45	Pass
26	0.005	0.071	0.0	0.006	0.106	5.98	Pass
27	0.022	0.083	26.1	0.023	0.125	18.30	Pass
28	0.006	0.066	0.0	0.007	0.099	7.07	Pass
29	0.029	0.078	36.9	0.030	0.116	25.75	Pass
30	0.019	0.061	31.1	0.020	0.092	21.93	Pass
31	0.042	0.073	58.3	0.044	0.109	39.97	Pass
32	0.012	0.058	21.0	0.013	0.086	15.55	Pass
33	0.021	0.068	31.3	0.023	0.102	22.51	Pass
34	0.010	0.054	19.1	0.012	0.081	14.86	Pass
35	0.006	0.064	0.0	0.008	0.096	8.01	Pass
36	0.032	0.051	61.7	0.034	0.077	43.75	Pass
37	0.004	0.061	0.0	0.005	0.091	5.35	Pass
38	0.030	0.048	62.9	0.033	0.073	45.41	Pass
39	0.008	0.058	13.9	0.010	0.087	11.45	Pass
40	0.015	0.046	33.2	0.020	0.069	28.66	Pass



**Voltage Source Verification Data (Run time)**

EUT: SMX3000RMHV2UNC – Green mode      Tested by: John Cushing  
 Test category: Class-A per Ed. 3.0 (2006) (European limits)      Test Margin: 100  
 Test date: 11/4/2010      Start time: 8:52:45 AM      End time: 9:03:05 AM  
 Test duration (min): 10      Data file name: H-001515.cts\_data  
 Comment: Equipment: California Instruments 5001ix      Site: EMC5 Temp: 22.6°C Humidity:  
 24% Pressure: 1008mbar  
 Customer: APC

Test Result: Pass      Source qualification: Normal

**Highest parameter values during test:**

Voltage (Vrms):	229.78	Frequency(Hz):	50.00
I_Peak (Amps):	19.240	I_RMS (Amps):	13.107
I_Fund (Amps):	13.136	Crest Factor:	1.476
Power (Watts):	2839.4	Power Factor:	0.945

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.071	0.460	15.45	OK
3	0.410	2.068	19.82	OK
4	0.046	0.460	10.08	OK
5	0.049	0.919	5.38	OK
6	0.022	0.460	4.84	OK
7	0.074	0.689	10.78	OK
8	0.032	0.460	6.89	OK
9	0.041	0.460	8.87	OK
10	0.046	0.460	10.02	OK
11	0.016	0.230	7.07	OK
12	0.025	0.230	10.90	OK
13	0.022	0.230	9.75	OK
14	0.020	0.230	8.91	OK
15	0.030	0.230	13.03	OK
16	0.039	0.230	16.99	OK
17	0.034	0.230	15.00	OK
18	0.050	0.230	21.61	OK
19	0.022	0.230	9.79	OK
20	0.036	0.230	15.80	OK
21	0.039	0.230	17.08	OK
22	0.036	0.230	15.82	OK
23	0.033	0.230	14.28	OK
24	0.009	0.230	4.03	OK
25	0.020	0.230	8.74	OK
26	0.007	0.230	3.13	OK
27	0.011	0.230	4.94	OK
28	0.014	0.230	6.01	OK
29	0.033	0.230	14.24	OK
30	0.023	0.230	10.16	OK
31	0.067	0.230	29.04	OK
32	0.022	0.230	9.70	OK
33	0.025	0.230	11.09	OK
34	0.030	0.230	12.88	OK
35	0.012	0.230	5.23	OK
36	0.042	0.230	18.15	OK
37	0.012	0.230	5.37	OK
38	0.041	0.230	17.94	OK
39	0.013	0.230	5.62	OK
40	0.044	0.230	19.02	OK

Table 23

**Flicker Test Summary per EN/IEC61000-3-3 (Run time)**

EUT: SMX3000RMHV2UNC – AVR mode  
 Test category: dt,dmax,dc and Pst (European limits)  
 Test date: 11/4/2010 Start time: 9:23:41 AM End time: 9:34:01 AM  
 Test duration (min): 10 Data file name: F-001517.cts\_data  
 Comment: Equipment: California Instruments 5001ix Site: EMC5 Temp: 22.6°C Humidity: 24% Pressure: 1008mbar  
 Customer: APC

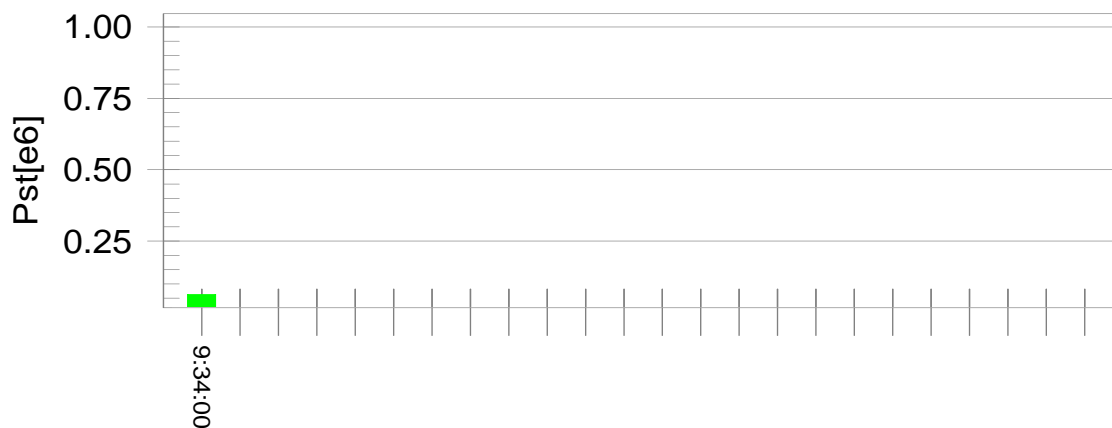
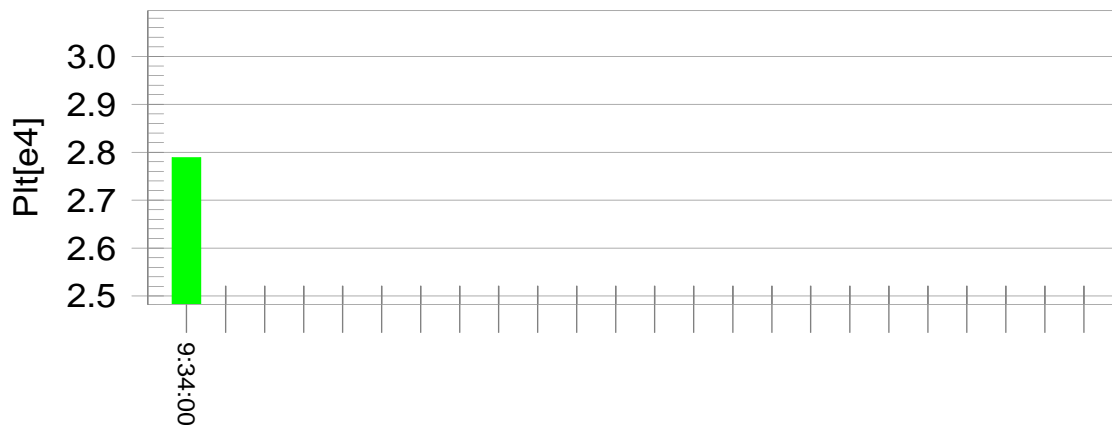
Tested by: John Cushing

Test Margin: 100

End time: 9:34:01 AM

Test Result: Pass

Status: Test Completed

Pst<sub>i</sub> and limit lineEuropean LimitsPlt and limit line**Parameter values recorded during the test:**

Vrms at the end of test (Volt):	229.68		
Highest dt (%):	0.00	Test limit (%):	3.30 Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0 Pass
Highest dc (%):	0.00	Test limit (%):	3.30 Pass
Highest dmax (%):	0.00	Test limit (%):	4.00 Pass
Highest Pst (10 min. period):	0.064	Test limit:	1.000 Pass



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Table 24

**Flicker Test Summary per EN/IEC61000-3-3 (Run time)**

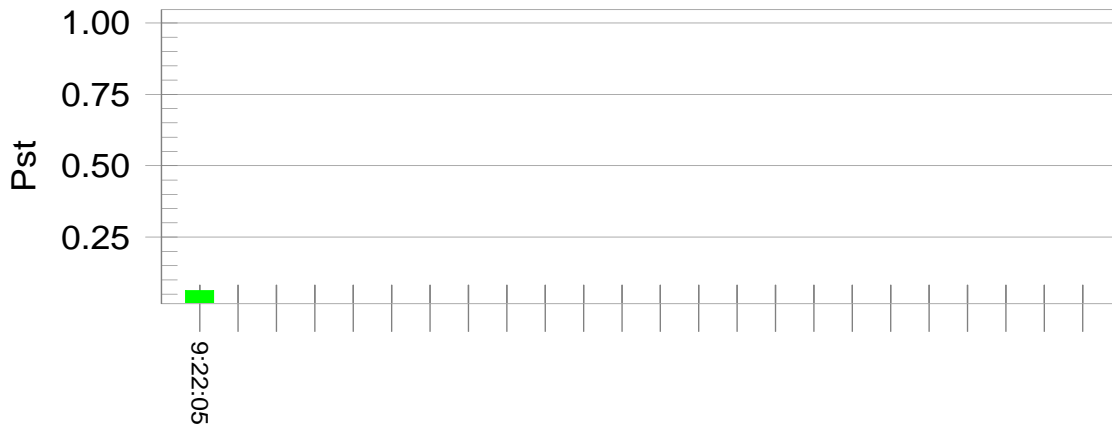
EUT: SMX3000RMHV2UNC – Green mode  
 Test category: dt,dmax,dc and Pst (European limits)  
 Test date: 11/4/2010 Start time: 9:11:45 AM End time: 9:22:05 AM  
 Test duration (min): 10 Data file name: F-001516.cts\_data  
 Comment: Equipment: California Instruments 5001ix Site: EMC5 Temp: 22.6°C Humidity: 24% Pressure: 1008mbar  
 Customer: APC

Test Result: Pass

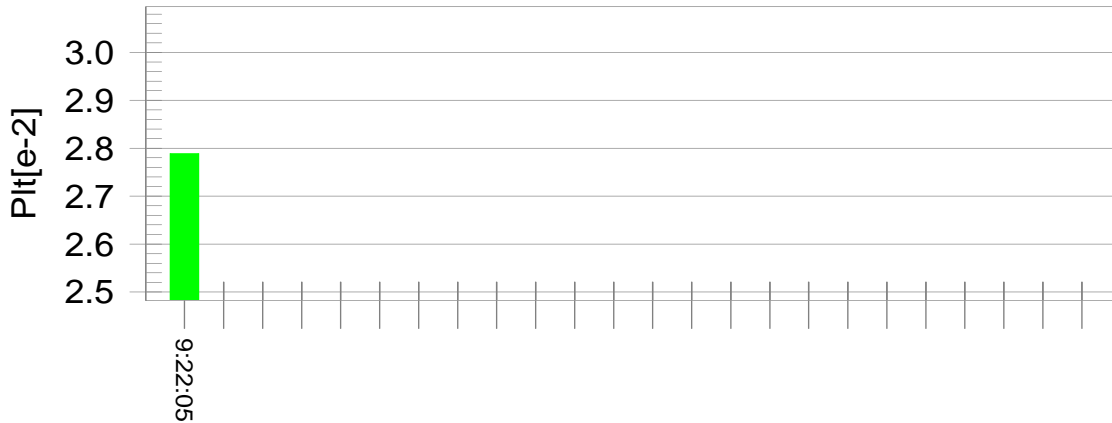
Status: Test Completed

Pst<sub>i</sub> and limit line

European Limits



Plt and limit line



**Parameter values recorded during the test:**

Vrms at the end of test (Volt):	229.74		
Highest dt (%):	0.00	Test limit (%):	3.30 Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0 Pass
Highest dc (%):	0.00	Test limit (%):	3.30 Pass
Highest dmax (%):	0.00	Test limit (%):	4.00 Pass
Highest Pst (10 min. period):	0.064	Test limit:	1.000 Pass



Rev: 4-Nov-2010

Harmonic & Flicker Analyzer	MN	Mfr	SN	Asset	Cat	Calibration Due
5001IX AC POWER SYSTEM	5001IX	CI	HK53687	376	II	27-Aug-2011

Meteorological Meters	MN	Mfr	SN	Asset	Cat	Calibration Due
Weather Clock (Pressure Only)	BA928	Oregon Scientific	C3166-1	831	I	17-Mar-2011
EMC5 Thermohygrometer	35519-044	Control Company	90823030	1497	II	20-Mar-2011

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

### Harmonics and Flicker Modifications:

In order to be compliant with Harmonics, firmware was updated to fix zero-crossing detection. Prior to the modification, the EUT would fail with a full load and no load.



**Harmonic Emissions and Voltage Fluctuations/Flicker Setup Photograph(s):**





## Meeting Harmonic Emissions Requirements:

REV 17-FEB-04

Power line harmonics are generated when a load draws a non-linear current from a sinusoidal voltage. Consider an ideal single phase line. If that line is a perfect sinusoidal voltage source, with zero source impedance, it would not matter how non-linear the attached equipment is. In the real world, however, wiring raises the power line impedance to a non-zero level. If a device demands an unusually high proportion of higher frequency harmonics, it will impose high frequency supply fluctuations on adjacent equipment. Some components, such as motor start/run capacitors, will dissipate excessive energy and be damaged. A second effect can be seen in three phase lines. Here, third harmonic energy winds up in phase, causing current to flow on the neutral lead. This situation has undesired safety consequences.

Switching power supplies are a common source of harmonics due to the discontinuous current drain which they present to the supply line. The increasing use of microprocessors and sensitive digital circuitry in many electronic products has given rise to increased concern over utility power quality. Low level digital circuitry is more sensitive to line variations than heavier industrial loads such as motors and standard lighting. Unfortunately, such devices also generally present non-linear loads to the power lines, which result in distortion on the supply in the form of harmonic generation and transients.

We measure the first 40 harmonic emissions of 50/60Hz in accordance with EN61000-3-2 using an HP test set.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test is covered by our A2LA accreditation.

## Meeting Voltage Fluctuation Requirements

REV 16-FEB-04

Household appliances and similar equipment, having electronic or electromechanical control devices, may produce voltage fluctuations in the supply systems they are attached to as the power demands of such equipment changes with time. In some installations the combination of these time varying current requirements and high supply system impedance can cause excessive changes in the power mains line voltage. If excessive voltage changes are repeated at short intervals of time, objectionable fluctuations of luminance (flicker) will be produced in lumination sources, e.g. an incandescent light bulb, connected to the same supply network.

EN 61000-3-3 specifies the measurements which must be made to ensure that these voltage fluctuations are kept to an acceptable level. The equipment under test is powered from a low impedance AC power main through a controlled impedance. Observations are made of the subjective flicker of a flicker meter to determine if the equipment is producing objectionable luminary flicker. The flicker meter implements a complex mathematical model of the human response to light flicker taking into account factors such as frequency, amplitude and duration of flicker events. All operating automatic modes of the equipment are evaluated. Changes caused by manual switching are not measured.



Examples of electrical equipment to which this requirement applies are appliances for cooking and heating, motor operated or magnetically driven appliances, and portable tools. Equipment which is connected to higher than 240 VAC single phase power mains or 415 VAC three phase power mains is excluded from testing as are devices which produce less than one voltage change per hour or more than 1800 per minute. Other types and applications of equipment are currently under consideration for inclusion in future drafts of the standard.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.



**LOW FREQUENCY CONDUCTED DISTURBANCE IMMUNITY****Test Method:**

In accordance with EN 61000-2-2.

**Results:**

TEST	RESULT	STANDARD	TEST LEVEL	COMMENTS
<i>Immunity to Low Frequency Signals</i>	PASS	EN 61000-2-2	10V	Performance Criteria A
<i>Voltage Unbalance</i>	N/A	EN 61000-2-2	N/A	EUT is not 3 phase equipment

## Low Frequency Conducted Disturbance Immunity Data Table(s):

Low Frequency Conducted Disturbance						
<b>Work Order:</b> K1310 <b>Date:</b> 17-Feb-11 <b>Engineer:</b> Chris Reynolds <b>EUT:</b> Colt HV <b>Company:</b> APC						
<b>Client Present:</b> David Wu						
<b>Testing Location:</b> Littleton Distribution Center, One Distribution Center Circle, #1 Littleton, MA 01460						
<b>Performance Criteria:</b> A						
<b>Maximum Test Parameters:</b> 10V AC						
<b>EUT Operating Voltage/Frequency:</b> 230Vac, 50Hz						
<b>Test Equipment Used:</b>						
<b>Harmonic &amp; Flicker Analyzer</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
5001IX AC POWER SYSTEM	5001IX	CI	HK53687	376	II	8/27/2011
<b>Meteorological Meters</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Temp./Humidity/Atm. Pressure Gauge	7400 Perception II	Davis	N/A	965	I	4/6/2011
EMC2 Thermohygrometer	35519-044	Control Company	72457653	1352	II	8/18/2011
<b>RMS Voltmeters/Current Clamp</b>	<b>MN</b>	<b>Mnfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
True RMS Multimeter	179	Fluke	89280616	1228	I	10/29/2011
<b>Atmospheric Conditions:</b>						
<b>Temp:</b> 19.2°C		<b>Humidity:</b> 20%		<b>Pressure:</b> 1007mbar		
<b>Results:</b>						
<b>Immunity To Low Frequency Signals</b>						
	<b>Test Level</b>	<b>Frequency Range</b>	<b>Result</b>	<b>Comment</b>		
AC Input	10V	140-360Hz	Pass			
<b>Voltage Unbalance</b>						
	<b>Test Level</b>	<b>Frequency Range</b>	<b>Result</b>	<b>Comment</b>		
AC Input	N/A	N/A	N/A	EUT is not 3 phase equipment		

## Modifications in place during testing:

See *Modifications Required for Compliance* section.

**Low Frequency Conducted Disturbance Immunity Setup Photograph(s):**



## Low Frequency Conducted Disturbance Immunity Testing Overview

REV 17-FEB-04

Some equipment is particularly sensitive to harmonic and interharmonic content from the AC mains. Such products can be damaged by frequency content above the mains frequency (i.e. capacitors across the line will experience increased heating). Others, such as uninterruptible power sources (UPS), which monitor the line quality, may mistake harmonic content for line failure. A UPS subject to low frequency disturbances may inadvertently switch off the line and begin discharging the battery while the mains is still supplying adequate 60/50 Hz power. The purpose of this test is to determine the effects of these harmonics in low-voltage supply networks on equipment that could be sensitive to such frequencies.

This is the harmonic emissions counterpart for susceptibility testing as required by the UPS product specific standard EN50091-2, which references ENV 61000-2-2 for specific test procedure, and IEC 1000-4-1 for guidelines on test equipment. The test voltage can consist of one or more continuous sine waves superimposed on the power supply voltage. The conditioning for 230 VAC/50 Hz units is done with a single sinusoidal disturbing voltage of 10  $V_{rms}$  at a frequency which is slowly varied from 140 Hz to 360 Hz. For other rated voltages and frequencies, conditioning is applied at a voltage and frequency range given by the following formula:

$$\text{Low end of frequency Range (Hz): } F_{low} = (F_{supply}) * 2.8$$

$$\text{High end of frequency Range (Hz): } F_{high} = (F_{supply}) * 7.2$$

$$\text{Disturbance Voltage: } V_{dist} = (V_{rated}) / 23$$

Where  $V_{rated}$  is the rated supply voltage for the equipment

Rated Voltage (V)	Disturbance Voltage (V)	$F_{supply}$ (Hz)	$F_{low}$ (Hz)	$F_{high}$ (Hz)
120	5.2	60	168	432
230	10	50	140	360

The conditioning is applied by a voltage source placed in series with the EUT in the neutral lead. Voltages generated by this source are then superimposed on the mains voltage seen by the EUT. For high current EUTs, the voltage source may be coupled through a buck/boost 10:1 transformer to limit the current through the voltage source to one tenth the amount flowing through the EUT. The voltage source is increased by a factor of ten to account for the transformer.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.





## Measurement Uncertainty

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Expanded Uncertainty k=2	Maximum allowable uncertainty
Radiated Emissions (30-1000MHz)		
NIST	5.6dB	N/A
CISPR	4.6dB	5.2dB (Ucisprr)
Radiated Emissions (1-26.5GHz)	4.6dB	N/A
Radiated Emissions (above 26.5GHz)	4.9dB	N/A
Magnetic Radiated Emissions	5.6dB	N/A
Conducted Emissions		
NIST	3.9dB	N/A
CISPR	3.6dB	3.6dB (Ucisprr)
Telco Conducted Emissions (Current)	2.9dB	N/A
Telco Conducted Emissions (Voltage)	4.4dB	N/A
Electrostatic Discharge	11.5%	N/A
Radiated RF Immunity (Uniform Field)	1.6dB	N/A
Electrical Fast Transients	23.1%	N/A
Surge	23.1%	N/A
Conducted RF Immunity	3dB	N/A
Magnetic Immunity	12.8%	N/A
Dips and Interrupts	2.3V	N/A
Harmonics	3.5%	N/A
Flicker	3.5%	N/A
Radio frequency (@ 2.4GHz)	$3.23 \times 10^{-8}$	$1 \times 10^{-7}$
RF power, conducted	0.40dB	0.75dB
Maximum frequency deviation:		
• Within 300Hz and 6kHz of audio frequency / Within 6kHz and 25kHz of audio frequency	3.4% 0.3dB	5% 3dB
Adjacent channel power	1.9dB	3dB
Conducted spurious emission of transmitter, valid up to 12.75GHz	2.39dB	3dB
Conducted emission of receivers	1.3dB	3dB
Radiated emission of transmitter, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of transmitter, valid up to 80GHz	3.3dB	6dB
Radiated emission of receiver, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of receiver, valid up to 80GHz	3.3dB	6dB
Humidity	2.37%	5%
Temperature	0.7°C	1.0°C
Time	4.1%	10%
RF Power Density, Conducted	0.4dB	3dB
DC and low frequency voltages	1.3%	3%
Voltage (AC, <10kHz)	1.3%	2%
Voltage (DC)	0.62%	1%
The above reflects a 95% confidence level		



## Product Documentation

Client test plan:

1. Radiated Emissions: EN 55022/FCC part 15/CISPR22/VCCI/ICES-003 Class A
2. AC mains conducted emission: EN 55022/FCC part 15/CISPR22/VCCI/ICES-003 Class A
3. Telco Line Conduct Emissions: EN 55022 Class A
4. Telco surge susceptibility and immunity: IEC 61000-4-5 (Ethernet cable only) +/-1 kV
5. AC input and output conducted surge susceptibility and immunity: IEC 61000-4-5, +/-6 kV
6. Conducted RF Immunity: IEC 61000-4-6, 10Vac from 150kHz to 80MHz
7. Voltage dips And short interruptions: IEC 61000-4-11
8. Immunity to low frequency magnetic field: IEC 61000-4-16, 10Vac 140-360Hz
9. Harmonics: IEC 61000-3-2 Class A
10. Flicker: IEC 61000-3-3
11. Electrostatic discharge port immunity: Per IEC 61000-4-2, level 3 (+/-6 kV) contact discharge
12. Electrostatic discharge immunity: IEC 61000-4-2, +/-10 kV air discharge and +/-8 kV contact discharge
13. Electromagnetic continuous radiated susceptibility and immunity: IEC 61000-4-3 with maximum field strength of 10 V/m from 27MHz to 6GHz
14. Electrical Fast Transient immunity: IEC 61000-4-4 withstand 4kV level for AC mains, 2kV for others
15. Generated magnetic fields: Measure generated magnetic fields at 1m distant and measure distant magnetic field is at 0.5 gauss
16. Electromagnetic burst immunity: per MIL-STD-462 Method RS01 with amplitudes up to 2.3 x 10e-3
17. Audible noise: ISO 7779/ANSI S12.10



## ***Jurisdictional Labeling and Required Instruction Manual Inserts***

### **CE Marking - European Union (EU)**

The CE mark is affixed by a manufacturer to its product in order to demonstrate to customs and other officials that the product marked is in conformity with all applicable European Union (EU) Directives. The CE mark must take the form shown below and must be affixed to the product unless the product is too small. If the product is too small, the CE mark may be affixed to the packaging, instructions for use or the guarantee certificate. The CE mark must be a minimum 5mm in height.

It is customary to include the written Declaration of Conformity with the shipment of the product as well in case of questions at the border. Supplying the Declaration of Conformity with the product is not required, it's just good preventative practice. It is required that the directive be held available to EU officials for a period of ten years following the placement of the product on the market.



The CE marking is available in bit-mapped form from the Curtis-Straus web site at <http://www.curtis-straus.com> or call us for a complementary disk.

### **Sample Declaration of Conformity**

Declaration of conformity  
Konformitätserklärung  
Déclaration de conformité  
Declaración de Conformidad  
Verklaring de overeenstemming  
Dichiarazione di conformità

We/Wir/ Nous/WIJ/Noi: **COMPANY NAME**  
**ADDRESS**

declare under our sole responsibility that the product,  
erklären, in alleniniger Verantwortung, daß dieses Produkt,  
déclarons sous notre seule responsabilité que le produit,  
declaramos, bajo nuestra sola responsabilidad, que el producto,  
verklaren onder onze verantwoordelijkheid, dat het product,  
dichiariamo sotto nostra unica responsabilità, che il prodotto,

#### **MODEL NUMBER**

#### **SERIAL NUMBER RANGE**

to which this declaration relates is in conformity with the following standard(s) or other normative documents.  
auf das sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder Richtlinie(n) übereinstimmt.  
auquel se réfère cette déclaration est conforme à la (aux) norme(s) ou au(x) document(s) normatif(s).  
al que se refiere esta declaración es conforme a la(s) norma(s) u otro(s) documento(s) normativo(s).  
waarnaar deze verklaring verwijst, aan de volende norm(en) of richtlijn(en) beantwoordt.  
a cui si riferisce questa dichiarazione è conforme alla/e seguente/i norma/o documento/i normativo/i.

**LIST OF DIRECTIVES AND EN'S TO WHICH CONFORMANCE IS CLAIMED (Including Title and edition date).**

**SIGNATURE OF RESPONSIBLE PARTY, DATE, and PLACE OF ISSUE**



## EN 55022 Class A Warning Requirements

EN 55022 does not restrict the marketing of Class A information technology equipment, but does require it to include the following warning in the instructions for use.

### Warning

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

## FCC Requirements

### Required Equipment Authorization for Device Type

Type of Device	Equipment Authorization Required
TV broadcast receiver	Verification
FM broadcast receiver	Verification
CB receiver	Declaration of Conformity or Certification
Superregenerative receiver	Declaration of Conformity or Certification
Scanning receiver	Certification
Radar detector	Certification
All other receivers subject to part 15	Declaration of Conformity or Certification
TV interface device	Declaration of Conformity or Certification
Cable system terminal device	Declaration of Conformity
Stand-alone cable input selector switch	Verification
Class B personal computers and peripherals	Declaration of Conformity or Certification
CPU boards and internal power supplies used with Class B personal computers	Declaration of Conformity or Certification
Class B personal computers assembled using authorized CPU boards or power supplies	Declaration of Conformity
Class B external switching power supplies	Verification
Other Class B digital devices & peripherals	Verification
Class A digital devices, peripherals & external switching power supplies	Verification
Access Broadband over Power Line (Access BPL)	Certification
All other devices	Verification

### FCC Required labeling for Verified Devices 47 CFR Part 15.19

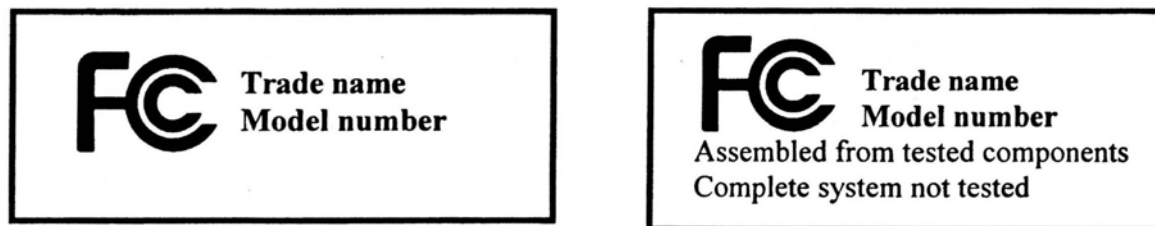
The specific labeling requirements for a device subject to the Verification or Certification procedure are contained in Section 15.19(a). These labelling requirements are:

- One of three compliance statements specified in Section 15.19(a);
- If the device is subject only to Verification include a label bearing a unique identifier - Section 2.954;
- If the device is subject to Certification (1) Section 2.925 contains information on identification of the equipment; (2) include a label bearing an FCC Identifier (FCC ID) - Section 2.926.

If the labeling area for the device is so small, and / or it is not practical to place the required statement on the device, then the statement can be placed in the user manual or product packaging - Section 15.19(a)(5). Generally, devices smaller than the palm of the hand are considered small. However, the device must still be labeled with the unique identifier (Verification) or the FCC ID (Certification).

#### **Declaration of Conformity (DoC):**

The labeling requirements for a device subject to the Declaration of Conformity (DoC) procedure are specified in Section 15.19(b). The label should include the FCC logo along with the Trade Name and Model Number, which satisfies the unique identifier requirement of Section 2.1074 if it represents the identical equipment tested for DoC compliance. For personal computers assembled from authorized components, the following additional text must also be included: "Assembled from tested components," "Complete system not tested." When the device is so small and / or when it is not practical to place the required additional text on the device, the text may be placed in the user manual or pamphlet supplied to the user. However, the FCC logo, Trade Name, and Model Number must still be displayed on the device - Section 15.19(b)(3).



Part 15 Declaration of Conformity (DoC) Label Examples

#### **FCC Required Instruction Manual Inserts CFR 47 Part 15.21 and 15.105**

Section 15.21 requires that in the user manual, the user shall be cautioned that changes / modifications not approved by the responsible party could void the user's authority to operate the equipment. The acceptable formats for user information dissemination are paper, computer disk or over the Internet. Where special accessories, such as shielded cables and/or special connectors, are required to comply with the emission limits, the instruction manual shall include appropriate instructions on the first page of the text describing the installation of the device (Section 15.27(a)).

For a Class A or Class B digital device (unintentional radiator), as well as any composite device that is both an intentional and unintentional radiator, the text specified in Section 15.105 must be placed in the user manual.

Devices authorized under the Declaration of Conformity (DoC) procedure must also include a compliance information statement (in the user manual or on a separate sheet) as required by Section 2.1077. The objective of this compliance statement is to allow the FCC to associate the equipment with the party responsible for compliance with the DoC requirements.

Devices certified as software defined radio that use an electronic labeling method to display the FCC ID must provide instructions in the user manual on how to access the electronic display (Section 2.925(e)).

Additional statements and information may be required for compliance to specific or general rule parts. The following is an example of some additional user information requirements. The party responsible for compliance must provide any additional statement(s) required.



- Kits - TV interface and Cable system terminal device marketed as Kits: Section 15.25 (d);
- TV interface devices, including cable system terminal devices: Section 15.115 (c) (5);
- Labeling of digital cable ready products: Section 15.123 - use of the term cable ready/compatible;
- External power amplifiers and antenna modifications: Section 15.204 (d) (2) – 1 notice of authorized amplifiers;
- Cordless telephones: Section 15.214 (c) & (d) (3) - privacy statement & security code statement;
- Cordless telephones: Section 15.233 (b) (2) (ii) - interference to TV;
- Cordless telephones: Section 15.233 (h) - cordless phones without digital security (Section 15.214);
- Professionally installed systems: Section 15.247 (c) (1) (iii);
- Operation within the Band 92-95 GHz: Section 15.257 (a) (4) - indoor use only;
- Unlicensed PCS: Section 15.311 - notification and coordination with UTAM, Inc.;
- RF exposure statements: Section 2.1091 (d) (3) - Mobile devices (a minimum separation distance may be required).

Our facility codes can be found in the *Test Equipment Used* Section starting on page 92.

## FCC Part 18 Required Labeling for Industrial, Scientific and Medical Equipment

### Labeling Requirements for Part 18 Devices:

Equipment that intentionally generates radio frequency energy for non telecommunications functions for industrial, scientific, medical (ISM) or other purposes must be authorized and labeled according to the procedures outlined in Part 2, Subpart J, Sections 18.203 and 18.209.

Non-consumer ISM equipment is authorized under the Verification procedure. Consumer ISM equipment is authorized under either the Declaration of Conformity or Certification procedure, except that consumer ultrasonic equipment generating less than 500 watts and operating below 90 KHz is subject to the Verification procedure.

Labeling for Verification requires a unique identifier (Section 2.954) to facilitate positive identification of the Verified device. The identification should not be confused with the FCC ID used on devices subject to Certification Labels for Part 18 devices subject to Certification require an FCC Identifier as described in Section 2.926.

For Declaration of Conformity the device shall be permanently labelled with the Part 18 logo (Section 18.209) illustrated below, in addition to a unique identifier (Section 2.1074) to facilitate positive identification.



Part 18 Declaration of Conformity (DoC) Logo

All [Artwork](#) shown above for Declaration of Conformity labels is available at:



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One Distribution Center Circle, #1 • Littleton, MA • TEL (978) 486-8880 • FAX (978) 486-8828



page 97 of  
103



<http://www.fcc.gov/labhelp> KDB Number 784748 (Select link on the left hand side “Detail Criteria Search” and in the Publication Number field enter 784748; then push the Submit Query button.)

### **User Manual and User Information for Part 18 Devices:**

For all industrial, scientific, medical (ISM) devices, the instruction manual or, if no instruction manual is provided, the product packaging must provide information that addresses the following: (1) interference potential of the device, (2) maintenance of the system and (3) simple measures that can be taken to correct interference. RF lighting devices must add a statement similar to the following: “This product may cause interference to radio equipment and should not be installed near maritime safety communications equipment, ships at sea or other critical navigation or communications equipment operating between 0.45-30 MHz.” (Section 18.213)

In addition, Part 18 devices that are authorized under the Declaration of Conformity procedure shall also include in the instruction manual, on a separate sheet, or on the packaging the following: identification of the product (e.g. name and model number), a statement similar to “This device complies with Part 18 of the FCC Rules” (Section 18.212), and the name and address of the responsible party (Section 2.909).

### **Multiple Authorization Procedures:**

A device subject to multiple authorization procedures requires appropriate testing and labeling for each of the respective authorization procedures. As a general rule, the Declaration of Conformity (DoC) text statement is required over any Verification statement. For devices subject to DoC and Verification, or Certification and Verification, the labeling requirements for DoC or Certification need only apply. When a device is authorized under both DOC and Certification procedures, the DoC logo and FCC ID (or FCC IDs if applicable) are required.

This requirement does not negate the testing requirement for each individual device that is subject to both multiple authorization procedures, and / or multiple technical rules. For example, an 802.11 WIFI Router that is also a CLASS B personal computer peripheral digital device must be tested as a computer peripheral (Section 15.3) and as a Digital Transmitter (Section 15.247) and must be labeled with the DoC logo and an FCC ID.

When supplying information to users, all relevant instructions that pertain to all components of a composite device are required. For example, Class A or Class B statements in Section 15.105; all warning statements and special instructions as required by Sections 15.21 and 15.27; and all Part 18 applicable instructions must be clearly stated. Variations in editing to clarify the language and structure are permitted if all the relevant points applicable to all of the components are represented.

## **Australian Communications and Media Authority (ACMA)**

### **Labeling**

Before a product can be marketed it must be labeled. Labeling for EMC is intended to provide a traceable link between a device and the supplier responsible for placing it on the Australian market, that is, the Australian manufacturer, importer or agent for an overseas manufacturer.

Under the EMC framework, manufacturers and importers of a device must satisfy certain requirements before a label can be affixed to a device. In general these involve completing the supplier's Declaration of Conformity and establishing a Compliance Folder.



### General Labeling Conditions

The label should meet the following specifications:

<b>Location:</b>	The label shall normally be placed on the external surface of the product as near as practical to the model identification. Where this is not practical, due to the size or nature of the product, the label may be placed on the labeling or packaging or warranty or instructions of this device. In addition the label may be placed on promotional material associated with the product.
<b>Method of Marking:</b>	The label shall be durably applied by any suitable means such as printing, painting, molding, etching and engraving. Reproduction shall be legible and conform the specifications for each mark.
<b>Scale:</b>	The label shall be legible with characters generally larger than 3mm.
<b>Color:</b>	The label may be reproduced in any color provided that visibility is assured through either contrast with the background color or marking in relief (molding, engraving etc.)
<b>Identification of the supplier:</b>	Devices bearing the compliance mark shall also be marked with some means of identifying the person responsible for placing the product on the Australian market: In the case of products manufactured in Australia this will be the manufacturer. For devices manufactured outside Australia this will be the importer or agent of an overseas manufacturer/supplier.

The label may be affixed to a product at any point prior to its being offered for sale on the Australian market. The ACMA recognizes that for many imported products it will be more cost effective to label the product at the time of manufacture rather than to apply the label at the time of marketing and distribution. A product may not be offered for sale unless it is properly labeled and the Compliance Folder is complete. Penalties apply to the misuse of the label.

### C-Tick Mark

The C-Tick Mark is intended for use on all articles which conform with the EMC framework. The C-Tick Mark can also be used to show compliance with telecommunications and radiocommunications standards. For EMC compliance the C-Tick Mark must be accompanied by:

- The registered name and address of the place of business of the Australian supplier; or
- The Australian Company Number (ACN); or
- A supplier code issued by the ACMA; or
- Trademark/Name registered in Australia.

If the Trademark/Name option is to be used, registration details of the Trademark/Name should accompany the application. Suppliers may elect their preferred option for labeling using the C-Tick Mark. The components of the compliance label will be combined in such a manner that the C-Tick Mark and supplier identification information are contiguous.

Before a device is labeled with the C-Tick Mark the supplier must submit a written notice to the ACMA. A supplier is only required to submit one application to the ACMA advising of their intention to use the C-Tick Mark on all compliant products. The ACMA proposes that retailers and wholesalers satisfy themselves that a product is correctly labeled before offering it for sale.

### Regulatory Compliance Mark

The Regulatory Compliance Mark (RCM) is described in joint Australian and New Zealand standard AS/NZS 4417. The mark is intended for use by a number of regulators and covers main-connected devices. Some devices may be ineligible to use the mark and should therefore apply the C-Tick Mark. All devices that acquire a Certificate of Suitability for electrical safety

compliance will be eligible to use the RCM to denote EMC compliance once compliance has been established.

When using the RCM, the means of identifying the person responsible for placing a device on the Australian market will be through:

- The registered name and address of the place of business of the Australian supplier; or
- The Australian Company Number (ACN); or
- A supplier code issued by the ACMA; or
- Trademark/Name registered in Australia

Where a supplier intends to use the RCM for EMC compliance they should complete the application form in AS/NZS 4417 part 3.

Further information can be found at the ACMA web site at <http://www.acma.gov.au/acmainter> .

## Canadian Requirements

Digital products and ISM products must be labeled by a notice in French and English. The notice **must** take the form of a label on the product. As an alternative, where it is not feasible to label the product due to product size or other consideration, the notice must be reproduced in the manual. Note that considerations such as product appearance are not considered to meet the feasibility test. The notice must state that the product is in compliance with Canadian Interference-Causing Equipment regulations and may be in your own words. A suggested text is:

### For ITE products:

This Class A or B digital apparatus complies with Canadian ICES-003.

Cet appareil numerique de la classe A or B est conforme a la norme NMB-003 du Canada.

### For ISM products:

This ISM apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Ce generateur de frequence radio ISM respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

Although the ITE limits are different from the FCC in some minor ways, equipment which complies with the FCC limits is considered by Industry Canada to be compliant with the Canadian rules. For ITE, equipment in compliance with either FCC Part 15 or CISPR 22 is considered to meet ICES-003. ISM equipment limits are the same as the EU EN55011 emission limits. Reports must be kept on file for review by the appropriate Canadian Minister for a period of five years.

Our facility codes can be found in the *Test Equipment Used* Section starting on page 92.

## VCCI Requirements

In order to comply with VCCI and appropriately label your product, you must be a member of the Voluntary Control Council for Interference (VCCI). Every company is eligible to join the VCCI. Membership dues are assessed based on company size and vary from 200,000 yen to 800,000 yen (about \$2,000 to \$8,000) per year. Since the VCCI fiscal year commences April 1, it may be prudent to wait for April if that month is near to avoid paying double dues.

This report contains the information you need to fill out the Conformity Verification Report. Once filled out, it must be sent to VCCI. You must also label your product with the appropriate class A or class B mark and supply the required user information in your manual. The Conformity Verification Report label marks and other VCCI forms, documents and instructions can be found at the VCCI member page [http://www.vcci.or.jp/vcci\\_e/member/index.html](http://www.vcci.or.jp/vcci_e/member/index.html).

There are two ways to submit your report to VCCI: by postal mail and by Internet. For more information regarding the VCCI internet submission service, go to [http://www.vcci.or.jp/vcci\\_e/member/news/index6.html](http://www.vcci.or.jp/vcci_e/member/news/index6.html)

Curtis-Straus, the measurement facility, is a VCCI supporting member Rank D, acceptance number 818. Our facility codes can be found in the *Test Equipment Used* Section starting on page 92.



## Conditions Of Testing

[Bureau Veritas Consumer Products Services, Inc., a Massachusetts corporation], and/or its affiliates (collectively, the "Company") will conduct, at the request of the Submitter ("Client"), the tests specified on the submitted Test Request Form or equivalent in accordance with, and subject to, the following terms and conditions (collectively, "Conditions"):

1. All orders for tests are subject to acceptance by the Company, and no order will constitute a binding commitment of the Company unless and until such order is accepted by it, as evidenced by the issuance of a written report ("Test Report") by the Company. The Test Report is issued solely by the Company, is intended for the exclusive use of Client and shall not be published, used for advertising purposes, copied or replicated for distribution to any other person or entity or otherwise publicly disclosed without the prior written consent of the Company. By submitting a request for services to the Company, Client consents to the disclosure to accreditation bodies of those records of Client relevant to the accreditation body's assessment of the Company's competence and compliance with relevant accreditation criteria. The Company shall not be liable for any loss or damage whatsoever resulting from the failure of the Company to provide its services within any time period for completion estimated by the Company. If Client anticipates using the Test Report in any legal proceeding, arbitration, dispute resolution forum or other proceeding, it shall so notify the Company prior to submitting the Test Report in such proceeding. The Company has no obligation to provide a fact or expert witness at such proceeding unless the Company agrees in advance to do so for a separate and additional fee.
2. The Test Report will set forth the findings of the Company solely with respect to the test samples identified therein. Unless specifically and expressly indicated in the Test Report, the results set forth in such Test Report are not intended to be indicative or representative of the quality or characteristics of the lot from which a test sample is taken, and Client shall not rely upon the Test Report as being so indicative or representative of the lot or of the tested product in general. The Test Report will reflect the findings of the Company at the time of testing only, and the Company shall have no obligation to update the Test Report after its issuance. The Test Report will set forth the results of the tests performed by the Company based upon the written information provided to the Company. The Test Report will be based solely on the samples and written information submitted to the Company by Client, and the Company shall not be obligated to conduct any independent investigation or inquiry with respect thereto.
3. The Company may, in its sole discretion, destroy samples which have been furnished to the Company for testing and which have not been destroyed in the course of testing. The Company may delegate the performance of all or a portion of the services contemplated hereunder to an affiliate, agent or subcontractor of the Company, and Client consents to such delegation.
4. These Conditions and the Test Report represent the entire understanding of the parties hereto with respect to the subject matter hereof and of the Test Report, and no modification, variance or extrapolation with respect thereto shall be permitted without the prior written consent of the Company.
5. The names, service marks, trademarks and copyrights of the Company and its affiliates, including the names "BUREAU VERITAS," "BUREAU VERITAS CONSUMER PRODUCTS SERVICES," "BVCPS," "MTL," "ACTS," "MTL-ACTS" and "CURTIS-STRAUS" (collectively, the "Marks") are and shall remain the sole property of the Company or its affiliates and shall not be used by Client except solely to the extent that Client obtains the prior written approval of the Company and then only in the manner prescribed by the Company. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of the Company or its affiliates.
6. Payment in full shall be due 30 days after the date of invoice. Interest shall be due on overdue amounts from the due date until paid at an interest rate of 1.5% per month or, if less, the maximum rate permitted by law. The Company reserves the right, at any time and from time to time, to revoke any credit extended to Client. Client shall reimburse the Company for any costs it incurs in collecting past due amounts, including court costs and fees and expenses of attorneys and collection agencies. The Test Report may not be used or relied upon by Client if and for so long as Client fails to pay when due any invoice issued by the Company or any affiliate of it to Client or any affiliate or subsidiary of Client together with interest and penalties, if any, accrued thereon.
7. The Company disclaims any and all responsibility or liability arising out of or in connection with e-mail transmissions of such information.
8. Client understands and agrees that the Company is neither an insurer nor a guarantor, that the Company does not take the place of Client or any designer, manufacturer, agent, buyer, distributor or transportation or shipping company, and that the Company disclaims all liability in such capacities. Client further understands that if it seeks assurance against loss or damage, it should obtain appropriate insurance.
9. Client agrees that the Company, by providing the services, does not take the place of Client nor any third party, nor does the Company release them from any of their obligations, nor does the Company otherwise assume, abridge, abrogate or undertake to discharge any duty of any third party to Client or any duty of Client or any third party to any other third party, and Client will not release any third party from its obligations and duties with respect to the tested goods.
10. Client shall, on a timely basis, (a) provide adequate instructions to the Company in order to enable the Company to perform properly its services, (b) provide, or cause Client's suppliers and contractors to provide, the Company with all documents necessary to enable the Company to perform its services, (c) furnish the Company with all relevant information regarding Client's intended use and purposes of the tested goods, (d) advise the Company of essential dates and deadlines relevant to the tested goods and (e) fully exercise all rights and remedies available to Client against third parties in respect of the tested goods.
11. The Company shall undertake due care and ordinary skill in the performance of its services to Client, and the Company shall accept responsibility only where such skill has not been exercised and, even in such event, only to the extent of the limitation of liability set forth herein.
12. If Client desires to assert a claim arising from or relating to (i) the performance, purported performance or non-performance of any services by the Company or (ii) the sale, resale, manufacture, distribution or use of any tested goods, it must submit that claim to the Company in a writing that sets forth with particularity the basis for such claim within 60 days from discovery of the potential claim and not more than six months after the date of issuance of the Test Report to Client. Client waives any and all such claims including, without limitation, claims that the Test Report is inaccurate, incomplete or misleading or that additional or different testing is required, unless and then only to the extent that Client submits a written claim to the Company within both such time periods.
13. CLIENT SHALL, EXCEPT TO THE EXTENT OF COMPANY'S LIABILITY TO CLIENT HEREUNDER (WHICH IN NO EVENT SHALL EXCEED THE LIMITATION OF LIABILITY HEREIN), HOLD HARMLESS AND INDEMNIFY THE COMPANY, ITS



AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST ALL ACTUAL OR ALLEGED THIRD PARTY CLAIMS FOR LOSS, DAMAGE OR EXPENSE OF WHATSOEVER NATURE AND HOWSOEVER ARISING FROM OR RELATING TO (i) THE PERFORMANCE, PURPORTED PERFORMANCE OR NON-PERFORMANCE OF ANY SERVICES BY THE COMPANY OR (ii) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY TESTED GOODS.

14. EXCEPT AS MAY OTHERWISE BE EXPRESSLY AGREED TO IN WRITING BY THE COMPANY AND NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN OR IN ANY TEST REPORT, NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, IS MADE.

15. (A) IN NO EVENT WHATSOEVER SHALL THE COMPANY BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE TEST REPORT OR THE SERVICES PROVIDED BY THE COMPANY HEREUNDER, INCLUDING WITHOUT LIMITATION LOSS OF OR DAMAGE TO PROPERTY; LOSS OF INCOME, PROFIT OR USE; OR ANY CLAIMS OR DEMANDS MADE AGAINST CLIENT OR ANY OTHER PERSON BY ANY THIRD PARTY IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE SERVICES PROVIDED BY THE COMPANY HEREUNDER.

(B) NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN, AND IN RECOGNITION OF THE RELATIVE RISKS AND BENEFITS TO CLIENT AND THE COMPANY ASSOCIATED WITH THE TESTING SERVICES CONTEMPLATED HEREBY, THE RISKS HAVE BEEN ALLOCATED SUCH THAT UNDER NO CIRCUMSTANCES WHATSOEVER SHALL THE LIABILITY OF THE COMPANY TO CLIENT OR ANY THIRD PARTY IN RESPECT OF ANY CLAIM FOR LOSS, DAMAGE OR EXPENSE, OF WHATSOEVER NATURE OR MAGNITUDE, AND HOWSOEVER ARISING, EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF THE FEES PAID TO THE COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM OR U.S.\$10,000, WHICHEVER IS THE LESSER AMOUNT.

16. The Company shall not be liable for any loss or damage resulting from any delay or failure in performance of its obligations hereunder resulting directly or indirectly from any event of force majeure or any event outside the control of the Company. If any such event occurs, the Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

17. Company's services, including these Conditions, shall be governed by, and construed in accordance with, the local laws of the country where the Company performs the tests or, in the case of tests performed in the United States of America, the laws of Massachusetts without regard to conflicts of laws principles. If any aspect(s) of these Conditions is found to be illegal or unenforceable, the validity, legality and enforceability of all remaining aspects of these Conditions shall not in any way be affected or impaired thereby. Any proceeding related to the subject matter hereof shall be brought, if at all, in the courts of the country where the Company performs the tests or, in the case of tests performed in the United States of America, in the courts of Massachusetts. Client waives the right to interpose any counterclaim or setoffs of any nature in any litigation arising hereunder.

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