Test Report

CURTIS-STRAUS

Report No	EH0023-1
Client	APC Corporation Venkatraman Chennakesavan
Address	85 Rangeway Road North Billerica, MA 01862
Phone	978-670-2440
Items tested Also Compliant	SURT20KRMXLI with SURT192RMXLBP2 SURT15KRMXLI, SURT20KXLI, SURT15KXLI, SURT20KRMXLICH, SURT15KRMXLICH, SURT20KXLICH, SURT15KXLICH, SURT20KUXI, SURT15KUXI, SURT20KUXICH, SURT15KUXICH, SURT20KRMUXI, SURT15KRMUXI, SURT20KRMUXICH, SURT15KRMUXICH, SURT192XLBP2
Standards	IEC 62040-2:2003, EN 55022:1998/A1:2000/A2:2003, AS/NZS CISPR 22:2002, EN 55024:1998/A1:2001/A2:2003 (EN61000-4-2:1999, EN61000-4-3:1998, EN61000-4-4:1995, EN61000-4-5:1995, EN61000-4-6:1996)
Test Dates	January 8-9, 11-12, 15, 18, 23-26 and Feb 7-8, 2007
Results	As detailed within this report
Prepared by	Tuyen Truong – Test Engineer
Authorized by	John Underwood – EMC Manager
Issue Date	3/27/07
Conditions of Issue	This Test Report is issued subject to the conditions stated in the '*Conditions of Testing*' section on page 3 of this report.

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Form Final Report REV 2-16-07 (DW)

Summary

On January 8-9, 11-12, 15, 18, 23-26 and Feb 7-8, 2007 we tested the SURT20KRMXLI with SURT192RMXLBP2 for compliance with the following requirements:

EMC Emissions:
- EN 55022:1998/A1:2000/A2:2003 Class A ITE emissions requirements (EU)
- AS/NZS CISPR 22:2002 Class A ITE emissions requirements (Australia)
- IEC 62040-2:2003 Class A Uninterruptible power systems (UPS)

Registration numbers for all open area test sites can be found in the *Test Equipment Used* Section starting on page 3.

EMC Immunity:
- EN 55024:1998/A1:2001/A2:2003 ITE - immunity characteristics
  - EN61000-4-2:1999 Electrostatic discharge immunity
  - EN61000-4-3:1998 Radiated, radio-frequency, electromagnetic field immunity
  - EN61000-4-4:1995 Electrical fast transient/burst immunity
  - EN61000-4-5:1995 Surge immunity
  - EN61000-4-6:1996 Immunity to conducted disturbances, induce by radio-frequency fields

We found that the SURT20KRMXLI with SURT192RMXLBP2 met the above requirements with modification (See *Modification Required for Compliance* section on page 3). Mirza Beg and Mike Ingemi from APC Corporation were present during the testing. The test sample was received in good condition.
The SURT20KRMXLI with SURT192RMXLBP2 was tested in following 5 different configurations.

1. Single Phase Input, Single Phase Output with Hardwired output.
2. Single Phase Input, Single Phase Output with PDU output.
3. Three Phase Input, Single Phase Output with Hardwired output.
4. Three Phase Input, Single Phase Output with PDU output.
5. Three Phase Input, Three Phase Output with Hardwired output.

The Three Phase Input, Three Phase Output with Hardwired configuration represented the worst case among all configurations. Full testing was performed on Three Phase Input, Three Phase Output with Hardwired Output configuration. The Single Phase Input, Single Phase Output and Three Phase Input, Single Phase Output Hardwired configurations were only tested for Emissions in the worst case load. And the Single Phase Input, Single Phase Output and Three Phase Input, Single Phase Output PDU configurations were only tested for Emissions.

SURT20K and SURT15K series are also compliant since the SURT20KRMXLI with SURT192RMXLBP2 is baseline XLI UPS 20kVA rating and baseline APC Battery Solution and it was fully tested at worst case load (See figure 1 on the next page).

SKU	VA Rating	Market	Rack Hardware	Battery Solution	DESCRIPTION
SURT20KRMXLI	20	International	Included	APC	Baseline XLI UPS 20kVA rating. International Market, rack mount hardware included, APC battery solution.
SURT15KRMXLI	15	International	Included	APC	Similar to Baseline XLI UPS, but with VA limited rating to 15kVA
SURT20KXLI	20	International	NA	APC	Similar to Baseline XLI UPS, but without rack mount hardware
SURT15KXLI	15	International	NA	APC	Similar to Baseline XLI UPS, limited rating to 15kVA, without rack mount hardware.
SURT20KRMXLICH	20	China	Included	APC	Similar to Baseline XLI UPS, for China market
SURT15KRMXLICH	15	China	Included	APC	Similar to Baseline XLI UPS, limited rating to 15kVA, China market
SURT20KXLICH	20	China	NA	APC	Similar to Baseline XLI UPS, without rack mount hardware, China Market
SURT15KXLICH	15	China	NA	APC	Similar to Baseline XLI UPS, limited rating to 15kVA, without rack mount hardware, China mkt.
SURT20KUXI	20	International	NA	Not APC	Baseline UXI UPS 20KVA rating. International Market, No rack mount hardware included, non-APC battery solution (customer uses their own battery system.) Difference between this UPS and SURT20KRMXLI is the non-APC battery application and the rack mount hardware is not included.
SURT15KUXI	15	International	NA	Not APC	Similar to Baseline UXI UPS limited rating to 15kVA
SURT20KUXICH	20	China	NA	Not APC	Similar to Baseline UXI UPS, China market
SURT15KUXICH	15	China	NA	Not APC	Similar to Baseline UXI UPS, rating limited to 15kVA, China market
SURT20KRMUXI	20	International	Included	Not APC	Similar to Baseline UXI UPS, rack mounting hardware is included
SURT15KRMUXI	15	International	Included	Not APC	Similar to Baseline UXI UPS, rating limited to 15kVA, rack mounting hardware is included.
SURT20KRMUXICH	20	China	Included	Not APC	Similar to Baseline UXI UPS, rack mounting hardware is included, China market.
SURT15KRMUXICH	15	China	Included	Not APC	Similar to Baseline UXI UPS, limited to 15kVA,rack mounting hardware is included, China mkt
SURT192RMXLBP2	NA	Worldwide	Included	APC	Baseline APC Battery Solution for SURT20K, SURT15K series. Includes rack mount hardware.
SURT192XLBP2	NA	Worldwide	NA	APC	Similar to Baseline APC Battery solution for SURT20K, SURT15K series, but without rack mount hardware.

Figure 1: SURT20K and SURT15K series

Product Tested - Configuration Documentation

EUT Configuration

Work Order:	H0023
Company:	APC Corporation
Company Address:	85 Rangeway Road North Billerica, MA 01862
Contact:	Venkatraman Chennakesavan
Person Present:	Venkatraman Chennakesavan Mirza Beg Mike Ingemi

	MN	SN
EUT:	SURT20KRMXLI	Sample 1
Battery Pack including PDU:	SURT192RMXLBP2	Sample 1
EUT Description:	SURT20KRMXLI with SURT192RMXLBP2	
EUT Max Frequency:	50MHz	
EUT Min Frequency:	12MHz	

Support Equipment:	MN	SN
AVTRON Load	K490	353, 401, 395
IBM Laptop	600E	78-AVWB6
SYNOPTICS Ethernet Hub	2800	463187

EUT Cables:	Qty	Shielded?	Length	Ferrites
DB9 Serial Port	1	No	3 m	No
Webcard Ethernet	1	No	6 m	No
Humidity Probe	1	No	1m	No
Relay Contact	1	No	1m	No

Unpopulated EUT Ports:	Qty	Reason
DB9 Serial Port	1	N/A

Software / Operating Mode Description:

EUT is a UPS system. Testing charging and discharging at full and zero loads.

Performance Criteria

Criterion A: The unit must operate as intended during the test. In particular, EUT must continuously supply power to loads in charging or discharging modes without any errors or interruptions. Also the EUT status of the output power, voltage and current shall be monitored on a support laptop's web browser via Web card Ethernet (RJ45) cable. If the EUT output power, voltage and current drop to zero or EUT stops communicating with support laptop it is a failure.

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
Radiated Emissions	PASS	EN55022 / IEC62040-2 / AS/NZS CISPR 22	Class A	-2.3 dB @ 225 MHz	1 In 1 Out - Hardwired
				-2.1 dB @ 200 MHz	1 In 1 Out - PDU
				-2.5 dB @ 700 MHz	3 In 1 Out - Hardwired
				-4.4 dB @ 700 MHz	3 In 1 Out - PDU
				-1.5 dB @ 225 MHz	3 In 3 Out - Hardwired
AC Mains Conducted Emissions - Input	PASS	EN55022 / IEC62040-2 / AS/NZS CISPR 22	Class A	-9.96 dB @ 0.24 MHz	1 In 1 Out – Hardwired
				-14.4 dB @ 5.96 MHz	3 In 1 Out - Hardwired
				-2.1 dB @ 17.18 MHz	3 In 3 Out - Hardwired
AC Mains Conducted Emissions - Output	PASS	EN55022 / IEC62040-2 / AS/NZS CISPR 22	Class A	-2.1 dB @ 0.24 MHz	1 In 1 Out - PDU
				-3.9 dB @ 0.72 MHz	1 In 1 Out - Hardwired
				-2.95 dB @ 0.72 MHz	3 In 1 Out - Hardwired
				-2.4 dB @ 0.24 MHz	3 In 1 Out - PDU
				-5.0 dB @ 0.15 MHz	3 In 3 Out - Hardwired
Telco Line Conducted Emissions	PASS	EN55022	Class A	-12.14 dB @ 23.12 MHz	
RFI - Amplitude Modulated	PASS	EN61000-4-3	27 -1000 MHz 10 V/m 80% AM (1 kHz)	N/A	Performance Criteria A

TEST	RESULT	STANDARD	TEST LEVEL	MARGIN	COMMENTS
EFT	PASS	EN61000-4-4	±1.0kV AC mains, ±0.5kV other	N/A	Performance Criteria B
ESD	PASS	EN 61000-4-2	±4kV contact, ±8kV air	N/A	Performance Criteria B
CRFI	PASS	EN61000-4-6	10V, 0.15-80 MHz, 1kHz 80% AM	N/A	Performance Criteria A
AC Surge	PASS	EN61000-4-5	±2kV Common ±1kV Differential	N/A	Performance Criteria B
Telco Surge	N/A	EN61000-4-5	±1kV	N/A	No Outdoor Cables
Power-Frequency Magnetic Field	N/A	EN61000-4-8	3 A/m	N/A	No Magnetic Devices Built In
Voltage Dips	N/A	EN61000-4-11	<5%V for 10ms 70%V for 500ms	N/A	EUT Current rating is greater than 16 Amps per phase
Voltage Interruptions	N/A	EN 61000-4-11	<5%V for 5000ms	N/A	

Modifications Required for Compliance

In order for a SURT20KRMXLI with SURT192RMXLBP2 unit to pass AC surge:

Resistors R644 and R645 = 75K (PN:130-7502-z); R643 and R652 = 4.02K (PN: 130-4021-z); R642and R649 = 23.7K (PN:130-2372-z); R651 = 20K (PN: 130-2002-z); R648 = 7.15K (PN: 130-7151-z); capacitors C655=C656=C657=0.47uF and C658=0.1uF were implemented to the Logic Power Supply circuit of the EUT. The modification was also done by putting C655 and C657 in parallel with R652, C656 in parallel with R643 and C658 in parallel with R648. Prior to the modification, the EUT failed on negative Line-Earth discharges at 1kV in both Online and Bypass modes. In failure, EUT shuts off.

Test Results

Table 1

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 09-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2

Frequency Range: 30 to 1000 MHz **Measurement Distance:** 10 m

Notes: 1 phase in/1 phase out Hardwired

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	EN55022 - Class A and IEC62040-2 - Class A Limit (dBµV/m)	EN55022 - Class A and IEC62040-2 - Class A Margin (dB)	EN55022 - Class A and IEC62040-2 - Class A Result (Pass/Fail)
100 % charging												
v	200.0	41.1	22.2	8.9	1.5	29.3	---	---	---	40.0	-10.7	Pass
v	225.0	45.6	22.3	10.7	1.6	35.6	---	---	---	40.0	-4.4	Pass
h	300.0	38.6	22.3	12.8	2.0	31.1	---	---	---	47.0	-15.9	Pass
h	336.0	33.9	22.3	13.7	2.1	27.4	---	---	---	47.0	-19.6	Pass
h	368.0	33.8	22.2	14.5	2.2	28.3	---	---	---	47.0	-18.7	Pass
h	400.0	38.5	22.2	15.3	2.4	34.0	---	---	---	47.0	-13.0	Pass
h	500.0	37.6	22.1	17.1	2.8	35.4	---	---	---	47.0	-11.6	Pass
h	700.0	43.9	22.0	18.1	3.4	43.4	---	---	---	47.0	-3.6	Pass
h	720.0	27.8	22.0	18.3	3.5	27.6	---	---	---	47.0	-19.4	Pass
h	900.0	34.0	22.0	19.7	4.1	35.8	---	---	---	47.0	-11.2	Pass
h	960.0	27.0	21.8	20.2	4.2	29.6	---	---	---	47.0	-17.4	Pass
h	992.0	26.5	21.7	20.5	4.4	29.7	---	---	---	47.0	-17.3	Pass
h	1000.0	24.5	21.7	20.6	4.4	27.8	---	---	---	47.0	-19.2	Pass
100 % discharging												
v	200.0	40.1	22.2	8.9	1.5	28.3	---	---	---	40.0	-11.7	Pass
v	225.0	47.7	22.3	10.7	1.6	37.7	---	---	---	40.0	-2.3	Pass
h	300.0	39.5	22.3	12.8	2.0	32.0	---	---	---	47.0	-15.0	Pass
h	336.0	32.2	22.3	13.7	2.1	25.7	---	---	---	47.0	-21.3	Pass
h	368.0	36.8	22.2	14.5	2.2	31.3	---	---	---	47.0	-15.7	Pass
h	400.0	34.5	22.2	15.3	2.4	30.0	---	---	---	47.0	-17.0	Pass
h	500.0	34.9	22.1	17.1	2.8	32.7	---	---	---	47.0	-14.3	Pass
h	700.0	42.3	22.0	18.1	3.4	41.8	---	---	---	47.0	-5.2	Pass
h	720.0	29.8	22.0	18.3	3.5	29.6	---	---	---	47.0	-17.4	Pass
h	900.0	33.9	22.0	19.7	4.1	35.7	---	---	---	47.0	-11.3	Pass
h	960.0	25.6	21.8	20.2	4.2	28.2	---	---	---	47.0	-18.8	Pass
h	992.0	26.3	21.7	20.5	4.4	29.5	---	---	---	47.0	-17.5	Pass
h	1000.0	21.5	21.7	20.6	4.4	24.8	---	---	---	47.0	-22.2	Pass

Table Result: Pass by -2.3 dB ***Worst Freq:*** 225.0 MHz

Test Site: "M" **Pre-Amp:** Blue **Cable:** EMIR-11 **Analyzer:** Yellow **Antenna:** Green

Table 2

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 08-Feb-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2

Frequency Range: 30 to 1000 MHz **Measurement Distance:** 10 m

Notes: 1 Phase In/ 1 Phase Out PDU

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	CISPR Class A Limit (dBµV/m)	CISPR Class A Margin (dB)	CISPR Class A Result (Pass/Fail)
1 Phase In/ 1 Phase Out PDU - 100% Discharging												
h	700.0	44.3	24.4	18.1	3.4	41.4	---	---	---	47.0	-5.6	Pass
h	400.0	46.9	25.6	15.3	2.4	39.0	---	---	---	47.0	-8.0	Pass
h	450.0	39.8	25.7	16.2	2.5	32.8	---	---	---	47.0	-14.2	Pass
h	500.0	46.6	25.7	17.1	2.8	40.8	---	---	---	47.0	-6.2	Pass
v	225.0	43.0	24.6	10.7	1.6	30.7	---	---	---	40.0	-9.4	Pass
v	200.0	52.6	25.1	8.9	1.5	37.9	---	---	---	40.0	-2.1	Pass
1 Phase In/ 1 Phase Out PDU - 100% Charging												
v	200.0	49.3	25.1	8.9	1.5	34.6	---	---	---	40.0	-5.4	Pass
v	225.0	43.1	24.6	10.7	1.6	30.8	---	---	---	40.0	-9.2	Pass
h	500.0	47.0	25.7	17.1	2.8	41.2	---	---	---	47.0	-5.8	Pass
h	700.0	45.5	24.4	18.1	3.4	42.6	---	---	---	47.0	-4.4	Pass
h	400.0	44.8	25.6	15.3	2.4	36.9	---	---	---	47.0	-10.1	Pass
1 Phase In/ 1 Phase Out PDU - 0% Charging												
v	200.0	51.6	25.1	8.9	1.5	36.9	---	---	---	40.0	-3.1	Pass
v	225.0	43.5	24.6	10.7	1.6	31.2	---	---	---	40.0	-8.8	Pass
h	500.0	44.5	25.7	17.1	2.8	38.7	---	---	---	47.0	-8.3	Pass
h	700.0	43.1	24.4	18.1	3.4	40.2	---	---	---	47.0	-6.8	Pass
h	400.0	46.7	25.6	15.3	2.4	38.8	---	---	---	47.0	-8.2	Pass

Table Result: Pass by -2.1 dB ***Worst Freq:*** 200.0 MHz

Test Site: "M" **Pre-Amp:** Red **Cable:** EMIR-11 **Analyzer:** Red **Antenna:** Green

Note: Only frequencies with margins that are close to limits are repeated for measurement in different modes.

Table 3

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 09-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2

Frequency Range: 30 to 1000 MHz **Measurement Distance:** 10 m

Notes: 3 phase in/single out Hardwired

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	EN55022 - Class A and IEC62040-2 - Class A Limit (dBµV/m)	EN55022 - Class A and IEC62040-2 - Class A Margin (dB)	EN55022 - Class A and IEC62040-2 - Class A Result (Pass/Fail)
0% charging				---	---	---	---	---	---	---	---	---
vbb	57.0	50.1	22.2	6.9	0.6	35.4	---	---	---	40.0	-4.6	Pass
v	200.0	42.3	22.2	8.9	1.5	30.5	---	---	---	40.0	-9.5	Pass
v	225.0	44.7	22.3	10.7	1.6	34.7	---	---	---	40.0	-5.3	Pass
h	300.0	35.3	22.3	12.8	2.0	27.8	---	---	---	47.0	-19.2	Pass
h	400.0	37.5	22.2	15.3	2.4	33.0	---	---	---	47.0	-14.0	Pass
h	500.0	39.7	22.1	17.1	2.8	37.5	---	---	---	47.0	-9.5	Pass
h	700.0	43.7	22.0	18.1	3.4	43.2	---	---	---	47.0	-3.8	Pass
h	900.0	28.8	22.0	19.7	4.1	30.6	---	---	---	47.0	-16.4	Pass
100% charging			---	---	---	---	---	---	---	---	---	---
h	700.0	45.0	22.0	18.1	3.4	44.5	---	---	---	47.0	-2.5	Pass
100% discharging			---	---	---	---	---	---	---	---	---	---
h	700.0	42.4	22.0	18.1	3.4	41.9	---	---	---	47.0	-5.1	Pass
			---	---	---	---	---	---	---	---	---	---

Table Result: Pass by -2.5 dB ***Worst Freq:*** 700.0 MHz

Test Site: "M" **Pre-Amp:** Blue **Cable:** EMIR-11 **Analyzer:** Yellow **Antenna:** Green

Note: Only frequencies with margins that are close to limits are repeated for measurement in different modes.

Table 4

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 08-Feb-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2

Frequency Range: 30 to 1000 MHz **Measurement Distance:** 10 m

Notes:

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	EN55022 - Class A and IEC62040-2 - Class A Limit (dBµV/m)	EN55022 - Class A and IEC62040-2 - Class A Margin (dB)	EN55022 - Class A and IEC62040-2 - Class A Result (Pass/Fail)
3 Phase In/ 1 Phase Out PDU - 100% Discharging												
h	700.0	44.3	24.4	18.1	3.4	41.4	---	---	---	47.0	-5.6	Pass
v	200.0	45.9	25.1	8.9	1.5	31.2	---	---	---	40.0	-8.8	Pass
v	225.0	42.1	24.6	10.7	1.6	29.8	---	---	---	40.0	-10.2	Pass
h	300.0	46.3	25.6	12.8	2.0	35.5	---	---	---	47.0	-11.5	Pass
h	400.0	46.0	25.6	15.3	2.4	38.1	---	---	---	47.0	-8.9	Pass
h	500.0	46.5	25.7	17.1	2.8	40.7	---	---	---	47.0	-6.3	Pass
h	992.0	34.6	24.7	20.5	4.4	34.8	---	---	---	47.0	-12.2	Pass
3 Phase In/ 1 Phase Out PDU - 0% Charging												
h	700.0	45.5	24.4	18.1	3.4	42.6	---	---	---	47.0	-4.4	Pass
v	200.0	50.2	25.1	8.9	1.5	35.5	---	---	---	40.0	-4.5	Pass
v	225.0	41.7	24.6	10.7	1.6	29.4	---	---	---	40.0	-10.6	Pass
h	400.0	45.7	25.6	15.3	2.4	37.8	---	---	---	47.0	-9.2	Pass
h	500.0	44.6	25.7	17.1	2.8	38.8	---	---	---	47.0	-8.2	Pass
3 Phase In/ 1 Phase Out PDU - 100% Charging												
h	700.0	40.2	24.4	18.1	3.4	37.3	---	---	---	47.0	-9.7	Pass
v	225.0	44.6	24.6	10.7	1.6	32.3	---	---	---	40.0	-7.7	Pass
h	400.0	45.0	25.6	15.3	2.4	37.1	---	---	---	47.0	-9.9	Pass
h	450.0	42.1	25.7	16.2	2.5	35.1	---	---	---	47.0	-11.9	Pass
v	500.0	45.6	25.7	17.1	2.8	39.8	---	---	---	47.0	-7.2	Pass
h	336.0	39.9	25.5	13.7	2.1	30.2	---	---	---	47.0	-16.8	Pass
h	368.0	42.4	25.6	14.5	2.2	33.5	---	---	---	47.0	-13.5	Pass
h	300.0	44.8	25.6	12.8	2.0	34.0	---	---	---	47.0	-13.0	Pass
h	720.0	32.6	24.4	18.3	3.5	30.0	---	---	---	47.0	-17.0	Pass
h	960.0	34.0	24.8	20.2	4.2	33.6	---	---	---	47.0	-13.4	Pass
h	992.0	35.5	24.7	20.5	4.4	35.7	---	---	---	47.0	-11.3	Pass

Table Result: Pass by -4.4 dB ***Worst Freq:*** 700.0 MHz

Test Site: "M" **Pre-Amp:** Red **Cable:** EMIR-11 **Analyzer:** Red **Antenna:** Green

Note: Only frequencies with margins that are close to limits are repeated for measurement in different modes.

Table 5

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 09-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2

Frequency Range: 30 to 1000 MHz **Measurement Distance:** 10 m

Notes: 3 phase in/3 phase out Hardwired

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	EN55022 - Class A and IEC62040-2 - Class A Limit (dBµV/m)	EN55022 - Class A and IEC62040-2 - Class A Margin (dB)	EN55022 - Class A and IEC62040-2 - Class A Result (Pass/Fail)
100 % charging				---	---	---	---	---	---	---	---	---
vbb	57.0	47.4	22.2	6.9	0.6	32.7	---	---	---	40.0	-7.3	Pass
h	200.0	42.6	22.2	8.9	1.5	30.8	---	---	---	40.0	-9.2	Pass
v	225.0	43.4	22.3	10.7	1.6	33.4	---	---	---	40.0	-6.6	Pass
h	300.0	40.9	22.3	12.8	2.0	33.4	---	---	---	47.0	-13.6	Pass
h	400.0	36.7	22.2	15.3	2.4	32.2	---	---	---	47.0	-14.8	Pass
h	500.0	36.5	22.1	17.1	2.8	34.3	---	---	---	47.0	-12.7	Pass
h	700.0	44.2	22.0	18.1	3.4	43.7	---	---	---	47.0	-3.3	Pass
h	900.0	33.2	22.0	19.7	4.1	35.0	---	---	---	47.0	-12.0	Pass
100 % discharging												
vbb	57.0	47.4	22.2	6.9	0.6	32.7	---	---	---	40.0	-7.3	Pass
h	200.0	39.6	22.2	8.9	1.5	27.8	---	---	---	40.0	-12.2	Pass
v	225.0	45.5	22.3	10.7	1.6	35.5	---	---	---	40.0	-4.5	Pass
h	300.0	39.5	22.3	12.8	2.0	32.0	---	---	---	47.0	-15.0	Pass
h	400.0	34.5	22.2	15.3	2.4	30.0	---	---	---	47.0	-17.0	Pass
h	500.0	35.8	22.1	17.1	2.8	33.6	---	---	---	47.0	-13.4	Pass
h	700.0	39.4	22.0	18.1	3.4	38.9	---	---	---	47.0	-8.1	Pass
h	900.0	32.5	22.0	19.7	4.1	34.3	---	---	---	47.0	-12.7	Pass
0 % charging												
vbb	57.0	45.4	22.2	6.9	0.6	30.7	---	---	---	40.0	-9.3	Pass
h	200.0	44.9	22.2	8.9	1.5	33.1	---	---	---	40.0	-6.9	Pass
v	225.0	43.6	22.3	10.7	1.6	33.6	---	---	---	40.0	-6.4	Pass
h	300.0	39.6	22.3	12.8	2.0	32.1	---	---	---	47.0	-14.9	Pass
h	400.0	35.1	22.2	15.3	2.4	30.6	---	---	---	47.0	-16.4	Pass
h	500.0	35.6	22.1	17.1	2.8	33.4	---	---	---	47.0	-13.6	Pass
h	700.0	42.6	22.0	18.1	3.4	42.1	---	---	---	47.0	-4.9	Pass
h	900.0	29.7	22.0	19.7	4.1	31.5	---	---	---	47.0	-15.5	Pass
0 % discharging												
vbb	57.0	44.5	22.2	6.9	0.6	29.8	---	---	---	40.0	-10.2	Pass
h	200.0	42.6	22.2	8.9	1.5	30.8	---	---	---	40.0	-9.2	Pass
v	225.0	48.5	22.3	10.7	1.6	38.5	---	---	---	40.0	-1.5	Pass
h	300.0	38.6	22.3	12.8	2.0	31.1	---	---	---	47.0	-15.9	Pass
h	400.0	40.1	22.2	15.3	2.4	35.6	---	---	---	47.0	-11.4	Pass
h	500.0	36.9	22.1	17.1	2.8	34.7	---	---	---	47.0	-12.4	Pass
h	700.0	40.3	22.0	18.1	3.4	39.8	---	---	---	47.0	-7.2	Pass
h	900.0	32.5	22.0	19.7	4.1	34.3	---	---	---	47.0	-12.7	Pass

Table Result: Pass by -1.5 dB ***Worst Freq:*** 225.0 MHz

Test Site: "M" **Pre-Amp:** Blue **Cable:** EMIR-11 **Analyzer:** Yellow **Antenna:** Green

Note: Only frequencies with margins that are close to limits are repeated for measurement in different modes.

Table 6

AC Mains Conducted Emissions - Input — *Curtis-Straus LLC*

Date: 15-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Nobel Mathew **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: On Battery, 0% load, 1:1
Measurement Device: LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
Line 1 (Black LISN)					---	---	---	---	---	---	---	---
0.24	35.9		35.4		20.6	---	---	79.0	-22.5	66.0	-10.0	Pass
0.28	32.5		31.3		20.4	---	---	79.0	-26.1	66.0	-14.3	Pass
1.80	15.0		12.9		20.0	---	---	73.0	-38.0	60.0	-27.1	Pass
6.42	17.8		7.4		20.1	---	---	73.0	-35.1	60.0	-32.5	Pass
9.68	26.5		25.5		20.2	---	---	73.0	-26.3	60.0	-14.3	Pass
10.57	24.8		23.8		20.2	---	---	73.0	-28.0	60.0	-16.0	Pass
20.00	24.8		23.1		20.1	---	---	73.0	-28.1	60.0	-16.8	Pass
Neutral (White Black LISN)					---	---	---	---	---	---	---	---
0.24	34.9		35.0		20.6	---	---	79.0	-23.5	66.0	-10.4	Pass
0.28	32.7		32.4		20.5	---	---	79.0	-25.8	66.0	-13.1	Pass
6.43	17.5		7.8		20.3	---	---	73.0	-35.2	60.0	-31.9	Pass
9.67	27.3		26.3		20.2	---	---	73.0	-25.6	60.0	-13.5	Pass
10.68	23.7		22.7		20.2	---	---	73.0	-29.2	60.0	-17.2	Pass
12.75	16.4		10.7		20.2	---	---	73.0	-36.4	60.0	-29.1	Pass
20.00	23.7		21.9		20.2	---	---	73.0	-29.1	60.0	-17.9	Pass

Table Result: Pass by -9.96 dB ***Worst Freq:*** 0.24 MHz

Table 7

AC Mains Conducted Emissions - Input — *Curtis-Straus LLC*

Date: 15-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Nobel Mathew **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: On Battery, 100% load, 1:1
Measurement Device: LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
Neurtal (White Black LISN)					---	---	---	---	---	---	---	---
0.24	43.6		31.7		20.6	---	---	79.0	-14.8	66.0	-13.7	Pass
6.00	27.6		19.9		20.3	---	---	73.0	-25.1	60.0	-19.8	Pass
6.43	29.7		22.1		20.3	---	---	73.0	-23.0	60.0	-17.6	Pass
9.58	23.2		16.2		20.2	---	---	73.0	-29.6	60.0	-23.7	Pass
17.35	18.4		9.4		20.2	---	---	73.0	-34.4	60.0	-30.4	Pass
20.00	25.9		22.9		20.2	---	---	73.0	-26.9	60.0	-16.9	Pass
Line 1 (Black LISN)					---	---	---	---	---	---	---	---
0.24	44.6		32.7		20.6	---	---	79.0	-13.8	66.0	-12.7	Pass
1.69	14.8		7.7		20.0	---	---	73.0	-38.2	60.0	-32.3	Pass
5.94	27.7		20.2		20.1	---	---	73.0	-25.2	60.0	-19.7	Pass
6.33	32.0		24.8		20.1	---	---	73.0	-20.9	60.0	-15.1	Pass
9.55	22.8		19.2		20.2	---	---	73.0	-30.0	60.0	-20.6	Pass
14.35	23.5		21.2		20.2	---	---	73.0	-29.3	60.0	-18.6	Pass
19.76	26.3		14.5		20.1	---	---	73.0	-26.6	60.0	-25.4	Pass

Table Result: Pass by -12.67 dB ***Worst Freq:*** 0.24 MHz

Table 8

AC Mains Conducted Emissions - Input — *Curtis-Straus LLC*

Date: 15-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Nobel Mathew **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: Online, 0% load, 1:1
Measurement Device: Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
Line 1 (Black LISN)					---	---	---	---	---	---	---	---
6.10	26.1		22.9		20.1	---	---	73.0	-26.8	60.0	-17.0	Pass
7.10	25.2		24.4		20.1	---	---	73.0	-27.7	60.0	-15.5	Pass
9.15	22.7		18.0		20.1	---	---	73.0	-30.2	60.0	-21.9	Pass
10.32	27.8		23.5		20.2	---	---	73.0	-25.0	60.0	-16.3	Pass
14.25	23.0		18.4		20.2	---	---	73.0	-29.8	60.0	-21.4	Pass
20.00	26.3		23.0		20.1	---	---	73.0	-26.6	60.0	-16.9	Pass
Neutral (White-LISN)					---	---	---	---	---	---	---	---
1.24	16.2		10.7		20.1	---	---	73.0	-36.7	60.0	-29.2	Pass
6.27	23.2		20.8		20.3	---	---	73.0	-29.5	60.0	-18.9	Pass
7.24	26.5		24.2		20.3	---	---	73.0	-26.2	60.0	-15.5	Pass
11.00	26.5		24.4		20.2	---	---	73.0	-26.3	60.0	-15.4	Pass
14.41	23.3		19.0		20.2	---	---	73.0	-29.6	60.0	-20.9	Pass
20.00	25.1		22.2		20.2	---	---	73.0	-27.7	60.0	-17.7	Pass
					---	---	---	---	---	---	---	---

Table Result: Pass by -15.41 dB ***Worst Freq:*** 11.00 MHz

Table 9

AC Mains Conducted Emissions - Input — *Curtis-Straus LLC*

Date: 15-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Nobel Mathew **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: Online, 100% load, 1:1
Measurement Device: Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
Line 1 (Black LISN)					---	---	---	---	---	---	---	---
1.68	28.1		15.7		20.0	---	---	73.0	-24.9	60.0	-24.3	Pass
5.93	36.9		26.6		20.1	---	---	73.0	-16.1	60.0	-13.4	Pass
6.29	38.5		29.0		20.1	---	---	73.0	-14.4	60.0	-10.9	Pass
9.96	24.6		16.4		20.2	---	---	73.0	-28.3	60.0	-23.4	Pass
14.46	19.4		11.4		20.2	---	---	73.0	-33.4	60.0	-28.5	Pass
20.00	28.3		22.6		20.1	---	---	73.0	-24.6	60.0	-17.3	Pass
26.26	25.0		15.0		20.1	---	---	73.0	-27.9	60.0	-24.9	Pass
Neutral (White Black LISN)					---	---	---	---	---	---	---	---
1.35	25.4		12.4		20.1	---	---	73.0	-27.6	60.0	-27.5	Pass
5.52	30.3		19.4		20.3	---	---	73.0	-22.5	60.0	-20.3	Pass
6.10	38.1		27.4		20.3	---	---	73.0	-14.6	60.0	-12.3	Pass
9.91	28.1		24.4		20.2	---	---	73.0	-24.7	60.0	-15.4	Pass
14.50	26.4		15.5		20.2	---	---	73.0	-26.4	60.0	-24.4	Pass
23.11	23.7		13.4		20.2	---	---	73.0	-29.1	60.0	-26.4	Pass
25.76	25.0		15.1		20.2	---	---	73.0	-27.8	60.0	-24.7	Pass

Table Result: Pass by -10.88 dB ***Worst Freq:*** 6.29 MHz

Table 10

AC Mains Conducted Emissions - Input — *Curtis-Straus LLC*

Date: 15-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Nobel Mathew **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: Online, 0% load, 3:1
Measurement Device: LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
Neutral (White-Black LISN)												
5.99	22.5		20.5		20.3	---	---	73.0	-30.2	60.0	-19.2	Pass
7.00	20.7		19.3		20.3	---	---	73.0	-32.0	60.0	-20.4	Pass
9.99	27.3		24.2		20.2	---	---	73.0	-25.5	60.0	-15.6	Pass
11.00	23.4		21.4		20.2	---	---	73.0	-29.4	60.0	-18.4	Pass
14.51	19.7		17.7		20.2	---	---	73.0	-33.1	60.0	-22.1	Pass
19.99	23.0		18.3		20.2	---	---	73.0	-29.8	60.0	-21.5	Pass
27.34	10.0		3.1		20.3	---	---	73.0	-42.7	60.0	-36.6	Pass
Line 3 (Blue Black LISN)												
5.63	15.7		10.3		20.2	---	---	73.0	-37.1	60.0	-29.5	Pass
6.04	22.0		17.8		20.2	---	---	73.0	-30.8	60.0	-22.0	Pass
10.05	25.8		23.6		20.2	---	---	73.0	-27.0	60.0	-16.2	Pass
11.27	20.1		16.5		20.2	---	---	73.0	-32.7	60.0	-23.3	Pass
12.00	16.6		15.0		20.2	---	---	73.0	-36.2	60.0	-24.8	Pass
14.36	19.7		15.2		20.2	---	---	73.0	-33.1	60.0	-24.7	Pass
Line 2 (Red-Black LISN)												
6.15	20.6		16.2		20.2	---	---	73.0	-32.2	60.0	-23.6	Pass
7.10	18.3		17.7		20.2	---	---	73.0	-34.5	60.0	-22.1	Pass
9.76	22.3		19.3		20.2	---	---	73.0	-30.5	60.0	-20.5	Pass
10.21	24.4		22.6		20.2	---	---	73.0	-28.4	60.0	-17.2	Pass
14.30	18.9		13.5		20.2	---	---	73.0	-33.9	60.0	-26.3	Pass
20.00	23.1		19.0		20.1	---	---	73.0	-29.8	60.0	-20.9	Pass
Line 1 (Black LISN)												
1.86	12.3		7.9		20.0	---	---	73.0	-40.7	60.0	-32.1	Pass
6.00	20.4		14.0		20.1	---	---	73.0	-32.5	60.0	-25.9	Pass
7.13	18.9		19.0		20.1	---	---	73.0	-34.0	60.0	-20.9	Pass
9.99	24.9		20.0		20.2	---	---	73.0	-27.9	60.0	-19.8	Pass
11.11	22.4		21.9		20.2	---	---	73.0	-30.4	60.0	-17.9	Pass
14.57	19.1		17.5		20.2	---	---	73.0	-33.7	60.0	-22.3	Pass
20.00	23.7		19.3		20.1	---	---	73.0	-29.2	60.0	-20.6	Pass

Table Result: Pass by -15.57 dB ***Worst Freq:*** 9.99 MHz

Table 11

AC Mains Conducted Emissions - Input — *Curtis-Straus LLC*

Date: 15-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Nobel Mathew **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:**
Notes: Online, 100% load, 3:1
Measurement Device: LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
Line 1 (Black LISN)					---	---	---	---	---	---	---	---
1.65	19.2		11.5		20.0	---	---	73.0	-33.8	60.0	-28.5	Pass
5.88	30.0		22.7		20.1	---	---	73.0	-22.9	60.0	-17.2	Pass
6.19	27.1		20.1		20.1	---	---	73.0	-25.8	60.0	-19.8	Pass
10.03	25.3		21.9		20.2	---	---	73.0	-27.5	60.0	-17.9	Pass
19.35	19.1		12.5		20.1	---	---	73.0	-33.8	60.0	-27.4	Pass
26.97	15.2		7.6		20.1	---	---	73.0	-37.7	60.0	-32.3	Pass
Line 2 (Red-Black LISN)					---	---	---	---	---	---	---	---
5.96	30.1		22.6		20.2	---	---	73.0	-22.7	60.0	-17.2	Pass
6.33	27.0		19.7		20.2	---	---	73.0	-25.8	60.0	-20.1	Pass
9.88	23.7		22.1		20.2	---	---	73.0	-29.2	60.0	-17.7	Pass
14.72	23.1		20.1		20.2	---	---	73.0	-29.7	60.0	-19.7	Pass
20.00	21.4		12.7		20.1	---	---	73.0	-31.5	60.0	-27.2	Pass
26.93	16.4		9.0		20.2	---	---	73.0	-36.4	60.0	-30.8	Pass
Line 3 (Blue-Black LISN)					---	---	---	---	---	---	---	---
5.40	27.1		19.1		20.1	---	---	73.0	-25.8	60.0	-20.8	Pass
5.96	33.0		25.4		20.2	---	---	73.0	-19.8	60.0	-14.4	Pass
9.78	28.6		22.9		20.2	---	---	73.0	-24.2	60.0	-16.9	Pass
13.98	21.9		17.9		20.2	---	---	73.0	-30.9	60.0	-21.9	Pass
20.19	23.1		11.7		20.1	---	---	73.0	-29.8	60.0	-28.2	Pass
26.88	16.1		8.7		20.4	---	---	73.0	-36.5	60.0	-30.9	Pass
Neutral (White-Black LISN)					---	---	---	---	---	---	---	---
5.53	29.3		22.3		20.3	---	---	73.0	-23.4	60.0	-17.4	Pass
6.04	31.5		24.2		20.3	---	---	73.0	-21.2	60.0	-15.5	Pass
9.93	27.9		24.6		20.2	---	---	73.0	-24.9	60.0	-15.3	Pass
14.10	23.0		17.7		20.2	---	---	73.0	-29.8	60.0	-22.1	Pass
20.00	25.9		19.4		20.2	---	---	73.0	-26.9	60.0	-20.4	Pass
27.24	17.5		9.9		20.3	---	---	73.0	-35.2	60.0	-29.8	Pass

Table Result: Pass by -14.40 dB ***Worst Freq:*** 5.96 MHz

Table 12

AC Mains Conducted Emissions - Input — *Curtis-Straus LLC*

Date: 15-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Nobel Mathew **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: On Battery, 100% load, 3:1
Measurement Device: Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
Line 1 (Black LISN)					---	---	---	---	---	---	---	---
0.24	37.7		25.8		20.6	---	---	79.0	-20.7	66.0	-19.6	Pass
6.12	24.1		15.8		20.1	---	---	73.0	-28.8	60.0	-24.1	Pass
7.99	16.3		9.5		20.1	---	---	73.0	-36.7	60.0	-30.4	Pass
11.99	9.7		6.9		20.2	---	---	73.0	-43.1	60.0	-32.9	Pass
19.72	20.8		10.3		20.1	---	---	73.0	-32.1	60.0	-29.6	Pass
22.56	11.3		3.6		20.0	---	---	73.0	-41.7	60.0	-36.4	Pass
Line 2 (Red Black LISN)					---	---	---	---	---	---	---	---
0.22	25.7		18.9		20.7	---	---	79.0	-32.6	66.0	-26.4	Pass
1.56	13.0		8.9		20.1	---	---	73.0	-39.9	60.0	-31.0	Pass
5.85	22.5		14.7		20.2	---	---	73.0	-30.3	60.0	-25.1	Pass
8.05	16.6		9.5		20.2	---	---	73.0	-36.2	60.0	-30.3	Pass
14.60	20.3		18.2		20.2	---	---	73.0	-32.5	60.0	-21.6	Pass
20.68	18.3		11.4		20.1	---	---	73.0	-34.6	60.0	-28.6	Pass
0.24	38.6		26.3		20.6	---	---	79.0	-19.9	66.0	-19.1	Pass
Line 3(Blue Black LISN)					---	---	---	---	---	---	---	---
0.24	37.1		26.2		20.6	---	---	79.0	-21.3	66.0	-19.2	Pass
1.61	11.6		9.2		20.1	---	---	73.0	-41.3	60.0	-30.7	Pass
5.62	17.7		10.4		20.2	---	---	73.0	-35.1	60.0	-29.4	Pass
6.20	25.9		18.2		20.2	---	---	73.0	-26.9	60.0	-21.6	Pass
10.10	22.6		17.4		20.2	---	---	73.0	-30.2	60.0	-22.4	Pass
20.05	17.2		8.1		20.1	---	---	73.0	-35.7	60.0	-31.8	Pass
Neutral (White Black LISN)					---	---	---	---	---	---	---	---
0.23	28.2		19.4		20.7	---	---	79.0	-30.1	66.0	-25.9	Pass
1.64	20.0		14.0		20.1	---	---	73.0	-32.9	60.0	-25.9	Pass
5.98	26.1		18.4		20.3	---	---	73.0	-26.6	60.0	-21.3	Pass
6.58	22.6		14.9		20.3	---	---	73.0	-30.1	60.0	-24.8	Pass
9.46	20.6		21.3		20.2	---	---	73.0	-32.2	60.0	-18.5	Pass
14.44	19.9		14.5		20.2	---	---	73.0	-32.9	60.0	-25.3	Pass
20.32	19.6		12.5		20.2	---	---	73.0	-33.2	60.0	-27.3	Pass

Table Result: Pass by -18.50 dB ***Worst Freq:*** 9.46 MHz

Table 13

AC Mains Conducted Emissions - Input — *Curtis-Straus LLC*

Date: 15-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Nobel Mathew **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: On Battery, 0% load, 3:1
Measurement Device: Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
Line 1 (Black LISN)					---	---	---	---	---	---	---	---
0.24	28.4		27.8		20.6	---	---	79.0	-30.0	66.0	-17.7	Pass
0.27	27.3		26.8		20.5	---	---	79.0	-31.3	66.0	-18.7	Pass
6.24	10.3		0.2		20.1	---	---	73.0	-42.6	60.0	-39.7	Pass
9.62	21.4		20.2		20.2	---	---	73.0	-31.4	60.0	-19.6	Pass
10.74	20.9		19.7		20.2	---	---	73.0	-31.9	60.0	-20.1	Pass
12.55	14.0		12.1		20.2	---	---	73.0	-38.8	60.0	-27.7	Pass
14.36	18.9		17.6		20.2	---	---	73.0	-33.9	60.0	-22.2	Pass
Line 2 (Red Black LISN)					---	---	---	---	---	---	---	---
0.24	28.2		27.0		20.6	---	---	79.0	-30.2	66.0	-18.4	Pass
0.28	26.0		24.7		20.5	---	---	79.0	-32.5	66.0	-20.8	Pass
9.79	21.7		19.3		20.2	---	---	73.0	-31.1	60.0	-20.5	Pass
10.58	21.0		20.7		20.2	---	---	73.0	-31.8	60.0	-19.1	Pass
14.36	16.5		14.1		20.2	---	---	73.0	-36.4	60.0	-25.7	Pass
20.00	21.5		18.7		20.1	---	---	73.0	-31.4	60.0	-21.2	Pass
Line 3 (Blue Black LISN)					---	---	---	---	---	---	---	---
0.24	28.1		28.0		20.6	---	---	79.0	-30.3	66.0	-17.4	Pass
0.28	22.8		21.8		20.5	---	---	79.0	-35.7	66.0	-23.7	Pass
9.73	22.9		22.3		20.2	---	---	73.0	-29.9	60.0	-17.5	Pass
9.84	23.0		19.9		20.2	---	---	73.0	-29.8	60.0	-19.9	Pass
14.36	16.6		15.6		20.2	---	---	73.0	-36.2	60.0	-24.2	Pass
20.00	19.6		17.7		20.1	---	---	73.0	-33.3	60.0	-22.2	Pass
Neutral (Whte Black LISN)					---	---	---	---	---	---	---	---
0.24	29.0		28.5		20.6	---	---	79.0	-29.4	66.0	-16.9	Pass
0.28	25.5		23.9		20.5	---	---	79.0	-33.0	66.0	-21.6	Pass
9.46	21.7		20.0		20.2	---	---	73.0	-31.1	60.0	-19.8	Pass
9.68	23.8		22.7		20.2	---	---	73.0	-29.0	60.0	-17.2	Pass
10.53	22.2		21.5		20.2	---	---	73.0	-30.6	60.0	-18.3	Pass
11.44	18.0		16.9		20.2	---	---	73.0	-34.9	60.0	-22.9	Pass
20.00	21.7		18.6		20.2	---	---	73.0	-31.1	60.0	-21.2	Pass

Table Result: Pass by -16.93 dB ***Worst Freq:*** 0.24 MHz

Table14

AC Mains Conducted Emissions - Input *Curtis-Straus LLC*

Date: 12-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: Three In Three Out - Hardwired - INPUT
Measurement Device: Black LISN, Red-Black LISN, Blue-Black LISN, White-Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall
Frequency	QP1	QP2	AV1	AV2		Limit	Margin	qp Limit	qp Margin	AVE Limit	AVE Margin	Result
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dBµV)	dB	(dBµV)	dB	(dBµV)	dB	(Pass/Fail)
100% Load - Charging - Neutral					---	---	---	---	---	---	---	---
0.15	28.5		15.1		21.1	---	---	79.0	-29.4	66.0	-29.8	Pass
1.60	16.3		10.0		20.0	---	---	73.0	-36.7	60.0	-30.0	Pass
6.23	31.2		24.2		20.1	---	---	73.0	-21.7	60.0	-15.7	Pass
10.09	27.4		22.4		20.2	---	---	73.0	-25.4	60.0	-17.4	Pass
17.31	44.2		35.7		20.2	---	---	73.0	-8.6	60.0	-4.1	Pass
20.20	30.1		18.7		20.1	---	---	73.0	-22.8	60.0	-21.2	Pass
100% Load - Charging - Line 1					---	---	---	---	---	---	---	---
0.15		27.7		15.2	21.2	---	---	79.0	-30.1	66.0	-29.6	Pass
1.60		16.5		9.2	20.1	---	---	73.0	-36.4	60.0	-30.7	Pass
6.15		29.8		22.2	20.2	---	---	73.0	-23.0	60.0	-17.6	Pass
10.09		26.3		21.9	20.2	---	---	73.0	-26.5	60.0	-17.9	Pass
17.03		40.6		35.2	20.2	---	---	73.0	-12.2	60.0	-4.6	Pass
20.00		28.2		18.7	20.1	---	---	73.0	-24.7	60.0	-21.2	Pass
100% Load - Charging - Line 2					---	---	---	---	---	---	---	---
0.15	27.3		15.3		21.2	---	---	79.0	-30.5	66.0	-29.5	Pass
1.39	15.0		8.3		20.2	---	---	73.0	-37.8	60.0	-31.5	Pass
6.35	30.6		23.0		20.2	---	---	73.0	-22.2	60.0	-16.9	Pass
10.08	23.8		24.1		20.2	---	---	73.0	-29.0	60.0	-15.7	Pass
17.30	44.2		35.3		20.2	---	---	73.0	-8.6	60.0	-4.5	Pass
20.36	28.8		19.2		20.1	---	---	73.0	-24.1	60.0	-20.7	Pass
100% Load - Charging - Line 3					---	---	---	---	---	---	---	---
0.15		28.2		1.9	21.2	---	---	79.0	-29.6	66.0	-42.9	Pass
1.39		15.8		11.9	20.1	---	---	73.0	-37.1	60.0	-28.0	Pass
6.16		31.0		23.7	20.3	---	---	73.0	-21.7	60.0	-16.0	Pass
10.09		28.6		24.4	20.2	---	---	73.0	-24.2	60.0	-15.4	Pass
17.18		46.1		37.8	20.2	---	---	73.0	-6.7	60.0	-2.0	Pass
20.15		30.2		23.4	20.2	---	---	73.0	-22.6	60.0	-16.4	Pass
100% Load - Discharging - Neutral					---	---	---	---	---	---	---	---
0.24	28.3		20.6		20.6	---	---	79.0	-30.1	66.0	-24.8	Pass
1.60	11.5		12.6		20.0	---	---	73.0	-41.5	60.0	-27.4	Pass
6.30	25.2		17.9		20.1	---	---	73.0	-27.7	60.0	-22.0	Pass
14.90	27.2		21.2		20.2	---	---	73.0	-25.6	60.0	-18.6	Pass
16.80	40.2		35.4		20.2	---	---	73.0	-12.6	60.0	-4.4	Pass
20.05	29.2		22.0		20.1	---	---	73.0	-23.7	60.0	-17.9	Pass
100% Load - Discharging - Line 1					---	---	---	---	---	---	---	---
0.28		27.3		21.4	20.5	---	---	79.0	-31.2	66.0	-24.1	Pass
1.62		10.7		7.1	20.1	---	---	73.0	-42.2	60.0	-32.8	Pass
6.20		24.0		17.0	20.2	---	---	73.0	-28.9	60.0	-22.8	Pass
14.56		21.5		15.8	20.2	---	---	73.0	-31.3	60.0	-24.0	Pass
16.38		41.1		34.8	20.2	---	---	73.0	-11.7	60.0	-5.0	Pass
20.20		30.6		22.0	20.1	---	---	73.0	-22.3	60.0	-17.9	Pass
100% Load - Discharging - Line 2					---	---	---	---	---	---	---	---
0.28	26.3		21.6		20.5	---	---	79.0	-32.2	66.0	-23.9	Pass
1.60	9.8		6.7		20.1	---	---	73.0	-43.1	60.0	-33.2	Pass
9.70	26.6		23.7		20.2	---	---	73.0	-26.2	60.0	-16.1	Pass
14.85	22.8		13.2		20.2	---	---	73.0	-30.0	60.0	-26.6	Pass
16.90	43.8		35.6		20.2	---	---	73.0	-9.0	60.0	-4.2	Pass
20.27	30.7		20.9		20.1	---	---	73.0	-22.2	60.0	-19.0	Pass
100% Load - Discharging - Line 3					---	---	---	---	---	---	---	---
0.24		27.0		22.7	20.6	---	---	79.0	-31.4	66.0	-22.7	Pass
1.64		14.8		9.2	20.1	---	---	73.0	-38.1	60.0	-30.7	Pass
6.42		25.9		19.1	20.3	---	---	73.0	-26.8	60.0	-20.6	Pass
14.90		29.7		25.0	20.2	---	---	73.0	-23.1	60.0	-14.8	Pass
17.38		41.8		34.6	20.2	---	---	73.0	-11.0	60.0	-5.2	Pass
20.12		30.4		27.6	20.2	---	---	73.0	-22.4	60.0	-12.2	Pass

Table Result: Pass by -2.01 dB ***Worst Freq:*** 17.18 MHz

Table 15

AC Mains Conducted Emissions - Input — *Curtis-Straus LLC*

Date: 12-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: Three In Three Out - Hardwired - INPUT
Measurement Device: Black LISN, Red-Black LISN, Blue-Black LISN, White-Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		IEN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency	QP1	QP2	AV1	AV2		Limit	Margin	qp Limit	qp Margin	AVE Limit	AVE Margin	
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dBµV)	dB	(dBµV)	dB	(dBµV)	dB	(Pass/Fail)
0% Load - Charging - Neutral					---	---	---	---	---	---	---	---
0.15	26.1		11.7		21.1	---	---	79.0	-31.8	66.0	-33.2	Pass
1.64	9.6		3.6		20.0	---	---	73.0	-43.5	60.0	-36.4	Pass
10.00	27.0		23.5		20.2	---	---	73.0	-25.8	60.0	-16.3	Pass
11.06	18.9		16.5		20.2	---	---	73.0	-33.9	60.0	-23.3	Pass
17.12	32.3		23.7		20.2	---	---	73.0	-20.5	60.0	-16.1	Pass
20.00	22.4		18.6		20.1	---	---	73.0	-30.5	60.0	-21.3	Pass
0% Load - Charging - Line 1					---	---	---	---	---	---	---	---
0.15		24.2		11.2	21.2	---	---	79.0	-33.6	66.0	-33.6	Pass
1.75		8.5		3.4	20.1	---	---	73.0	-44.4	60.0	-36.5	Pass
7.35		24.0		22.2	20.2	---	---	73.0	-28.8	60.0	-17.6	Pass
10.10		23.5		21.4	20.2	---	---	73.0	-29.4	60.0	-18.4	Pass
17.20		30.8		22.8	20.2	---	---	73.0	-22.0	60.0	-17.1	Pass
20.00		22.2		17.9	20.1	---	---	73.0	-30.8	60.0	-22.0	Pass
0% Load - Charging - Line 2					---	---	---	---	---	---	---	---
0.15	24.3		10.7		21.2	---	---	79.0	-33.5	66.0	-34.1	Pass
1.28	8.6		5.0		20.2	---	---	73.0	-44.2	60.0	-34.8	Pass
7.38	23.6		22.9		20.2	---	---	73.0	-29.2	60.0	-16.9	Pass
10.05	27.0		23.9		20.2	---	---	73.0	-25.8	60.0	-15.9	Pass
16.97	33.0		25.1		20.2	---	---	73.0	-19.8	60.0	-14.7	Pass
20.05	24.3		18.9		20.1	---	---	73.0	-28.6	60.0	-21.0	Pass
0% Load - Charging - Line 3					---	---	---	---	---	---	---	---
0.15		24.4		3.0	21.2	---	---	79.0	-33.4	66.0	-41.8	Pass
1.20		7.6		5.6	20.1	---	---	73.0	-45.3	60.0	-34.4	Pass
9.90		26.7		23.0	20.2	---	---	73.0	-26.1	60.0	-16.8	Pass
10.20		25.9		23.1	20.2	---	---	73.0	-26.9	60.0	-16.7	Pass
16.76		32.4		23.7	20.2	---	---	73.0	-20.4	60.0	-16.1	Pass
20.02		20.0		18.7	20.2	---	---	73.0	-32.8	60.0	-21.1	Pass
0% Load - Discharging - Neutral					---	---	---	---	---	---	---	---
0.24	29.5		23.7		20.6	---	---	79.0	-28.9	66.0	-21.7	Pass
1.64	9.4		6.1		20.0	---	---	73.0	-43.6	60.0	-33.9	Pass
9.73	23.3		22.3		20.2	---	---	73.0	-29.5	60.0	-17.5	Pass
14.90	20.9		12.0		20.2	---	---	73.0	-31.9	60.0	-27.8	Pass
16.03	27.2		19.8		20.2	---	---	73.0	-25.6	60.0	-20.0	Pass
20.00	22.6		18.6		20.1	---	---	73.0	-30.3	60.0	-21.3	Pass
0% Load - Discharging - Line 1					---	---	---	---	---	---	---	---
0.24		29.2		27.0	20.6	---	---	79.0	-29.2	66.0	-18.4	Pass
1.75		9.7		7.0	20.1	---	---	73.0	-43.2	60.0	-32.9	Pass
9.57		21.4		20.6	20.2	---	---	73.0	-31.4	60.0	-19.3	Pass
10.58		18.4		16.8	20.2	---	---	73.0	-34.4	60.0	-23.0	Pass
16.87		26.2		18.6	20.2	---	---	73.0	-26.6	60.0	-21.2	Pass
20.00		21.4		17.1	20.1	---	---	73.0	-31.5	60.0	-22.8	Pass
0% Load - Discharging - Line 2					---	---	---	---	---	---	---	---
0.24	28.6		23.7		20.7	---	---	79.0	-29.7	66.0	-21.6	Pass
1.75	8.3		5.0		20.1	---	---	73.0	-44.6	60.0	-34.9	Pass
9.68	24.9		23.1		20.2	---	---	73.0	-28.0	60.0	-16.7	Pass
10.43	20.4		18.1		20.2	---	---	73.0	-32.4	60.0	-21.7	Pass
17.20	28.2		19.5		20.2	---	---	73.0	-24.6	60.0	-20.3	Pass
20.20	20.1		18.7		20.1	---	---	73.0	-32.8	60.0	-21.2	Pass
0% Load - Discharging - Line 3					---	---	---	---	---	---	---	---
0.24		30.0		26.6	20.6	---	---	79.0	-28.4	66.0	-18.8	Pass
1.75		10.1		7.4	20.1	---	---	73.0	-42.8	60.0	-32.5	Pass
9.62		24.9		24.3	20.2	---	---	73.0	-27.9	60.0	-15.5	Pass
14.90		20.5		12.0	20.2	---	---	73.0	-32.3	60.0	-27.8	Pass
16.68		32.3		24.2	20.2	---	---	73.0	-20.5	60.0	-15.6	Pass
20.00		19.4		18.8	20.2	---	---	73.0	-33.4	60.0	-21.0	Pass

Table Result: Pass by -14.71 dB ***Worst Freq:*** 16.97 MHz

Table 16

AC Mains Conducted Emissions - Output — *Curtis-Straus LLC*

Date: 08-Feb-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** Maine
Notes:
Measurement Device: Blue-Black LISN and Red-Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Red

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
1 Phase In 1 Phase Out - PDU - 100 % Charging - Neutral					---	---	---	---	---	---	---	---
0.24	53.8		40.5		20.6	---	---	93.0	-18.7	80.0	-19.0	Pass
0.36	53.3		41.7		20.4	---	---	93.0	-19.4	80.0	-17.9	Pass
0.48	63.6		51.0		20.4	---	---	93.0	-9.0	80.0	-8.6	Pass
0.84	43.9		32.8		20.3	---	---	87.0	-22.9	74.0	-20.9	Pass
5.00	44.1		34.1		20.1	---	---	87.0	-22.8	74.0	-19.8	Pass
5.60	50.1		35.8		20.2	---	---	87.0	-16.7	74.0	-18.0	Pass
11.40	37.3		36.6		20.2	---	---	87.0	-29.6	74.0	-17.2	Pass
1 Phase In 1 Phase Out - PDU - 100 % Charging - Line												
0.17		56.8		48.8	21.0	---	---	93.0	-15.2	80.0	-10.2	Pass
0.36		50.7		46.1	20.4	---	---	93.0	-21.9	80.0	-13.6	Pass
0.48		60.0		54.2	20.4	---	---	93.0	-12.6	80.0	-5.4	Pass
0.84		29.9		25.2	20.3	---	---	87.0	-36.8	74.0	-28.5	Pass
4.70		42.6		33.3	20.1	---	---	87.0	-24.3	74.0	-20.6	Pass
5.60		45.1		35.7	20.2	---	---	87.0	-21.7	74.0	-18.1	Pass
11.38		36.3		35.7	20.2	---	---	87.0	-30.5	74.0	-18.1	Pass
1 Phase In 1 Phase Out - PDU - 0% Charging - Neutral					---	---	---	---	---	---	---	---
0.24	39.5		32.9		20.6	---	---	93.0	-32.9	80.0	-26.5	Pass
0.51	48.1		45.6		20.4	---	---	87.0	-18.5	74.0	-8.0	Pass
0.96	29.4		27.1		20.2	---	---	87.0	-37.4	74.0	-26.7	Pass
4.58	29.3		23.1		20.1	---	---	87.0	-37.7	74.0	-30.8	Pass
6.10	31.4		28.1		20.2	---	---	87.0	-35.5	74.0	-25.7	Pass
9.80	37.3		35.0		20.2	---	---	87.0	-29.6	74.0	-18.9	Pass
11.70	35.9		35.2		20.2	---	---	87.0	-30.9	74.0	-18.6	Pass
1 Phase In 1 Phase Out - PDU - 0% Charging - Line					---	---	---	---	---	---	---	---
0.17		51.3		47.2	21.0	---	---	93.0	-20.7	80.0	-11.8	Pass
0.51		51.3		49.2	20.4	---	---	87.0	-15.3	74.0	-4.4	Pass
0.95		28.2		26.3	20.2	---	---	87.0	-38.6	74.0	-27.5	Pass
4.60		29.4		22.9	20.1	---	---	87.0	-37.5	74.0	-31.0	Pass
2.10		31.9		30.3	20.1	---	---	87.0	-35.0	74.0	-23.6	Pass
9.80		45.5		32.5	20.2	---	---	87.0	-21.3	74.0	-21.3	Pass
11.34		35.4		34.8	20.2	---	---	87.0	-31.4	74.0	-19.0	Pass
1 Phase In 1 Phase Out - PDU - 100% DisCharging - Neutral					---	---	---	---	---	---	---	---
0.18	63.9		49.5		21.0	---	---	93.0	-8.1	80.0	-9.5	Pass
0.24	67.7		57.3		20.6	---	---	93.0	-4.7	80.0	-2.1	Pass
0.48	61.1		54.7		20.4	---	---	93.0	-11.5	80.0	-4.9	Pass
0.84	41.7		34.4		20.3	---	---	87.0	-25.0	74.0	-19.3	Pass
4.69	32.8		24.0		20.1	---	---	87.0	-34.1	74.0	-29.9	Pass
9.80	37.8		27.5		20.2	---	---	87.0	-29.0	74.0	-26.3	Pass
1 Phase In 1 Phase Out - PDU - 100 % DisCharging - Line					---	---	---	---	---	---	---	---
0.18		63.3		48.1	21.0	---	---	93.0	-8.7	80.0	-10.9	Pass
0.24		61.8		55.8	20.6	---	---	93.0	-10.6	80.0	-3.6	Pass
0.48		59.4		55.5	20.4	---	---	93.0	-13.2	80.0	-4.1	Pass
0.84		30.6		23.8	20.3	---	---	87.0	-36.1	74.0	-29.9	Pass
5.04		32.2		25.4	20.1	---	---	87.0	-34.7	74.0	-28.5	Pass
6.13		36.9		29.2	20.2	---	---	87.0	-29.9	74.0	-24.6	Pass
10.50		28.9		23.8	20.2	---	---	87.0	-37.9	74.0	-30.0	Pass

Table Result: Pass by -2.10 dB ***Worst Freq:*** 0.24 MHz

Table 17

AC Mains Conducted Emissions - Output — *Curtis-Straus LLC*

Date: 12-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: Single In Single Out - Hardwired - OUTPUT
Measurement Device: Blue-Black LISN and White-Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
100% Load - charging - Line					---	---	---	---	---	---	---	---
0.15	61.4		45.9		21.2	---	---	93.0	-10.4	80.0	-12.9	Fail
0.38	45.3		38.7		20.5	---	---	93.0	-27.2	80.0	-20.8	Pass
0.84	47.2		38.5		20.3	---	---	87.0	-19.5	74.0	-15.2	Pass
1.21	40.2		27.6		20.2	---	---	87.0	-26.6	74.0	-26.2	Pass
19.80	45.8		39.7		20.1	---	---	87.0	-21.1	74.0	-14.2	Pass
20.00	47.9		36.9		20.1	---	---	87.0	-19.0	74.0	-17.0	Pass
100% Load - charging - Neutral					---	---	---	---	---	---	---	---
0.15		53.8		41.4	21.2	---	---	93.0	-18.0	80.0	-17.4	Pass
0.38		48.9		39.2	20.5	---	---	93.0	-23.6	80.0	-20.3	Pass
0.84		49.5		39.2	20.2	---	---	87.0	-17.3	74.0	-14.6	Pass
1.21		41.1		30.1	20.1	---	---	87.0	-25.8	74.0	-23.8	Pass
19.80		51.8		39.7	20.2	---	---	87.0	-15.0	74.0	-14.1	Pass
20.00		46.8		40.8	20.2	---	---	87.0	-20.0	74.0	-13.0	Pass
0% Load - charging - Line					---	---	---	---	---	---	---	---
0.15	60.9		46.5		21.2	---	---	93.0	-10.9	80.0	-12.3	Pass
0.28	42.5		37.3		20.5	---	---	93.0	-30.0	80.0	-22.2	Pass
0.92	29.6		26.3		20.2	---	---	87.0	-37.2	74.0	-27.6	Pass
5.50	29.3		24.2		20.2	---	---	87.0	-37.5	74.0	-29.6	Pass
19.50	38.1		33.8		20.1	---	---	87.0	-28.8	74.0	-20.1	Pass
20.10	33.3		31.5		20.1	---	---	87.0	-33.6	74.0	-22.4	Pass
0% Load - charging - Neutral					---	---	---	---	---	---	---	---
0.15		48.6		41.9	21.2	---	---	93.0	-23.2	80.0	-16.9	Pass
0.28		42.9		35.8	20.5	---	---	93.0	-29.6	80.0	-23.7	Pass
0.92		29.5		26.1	20.1	---	---	87.0	-37.4	74.0	-27.8	Pass
5.50		29.6		22.9	20.3	---	---	87.0	-37.1	74.0	-30.8	Pass
19.50		36.4		36.7	20.2	---	---	87.0	-30.4	74.0	-17.1	Pass
20.10		34.4		34.2	20.2	---	---	87.0	-32.4	74.0	-19.6	Pass
100% Load - Discharging - Line					---	---	---	---	---	---	---	---
0.15	64.5		48.4		21.2	---	---	93.0	-7.3	80.0	-10.4	Pass
0.24	56.4		53.4		20.6	---	---	93.0	-16.0	80.0	-6.0	Pass
0.72	61.6		49.8		20.3	---	---	87.0	-5.1	74.0	-3.9	Pass
1.38	45.8		40.7		20.2	---	---	87.0	-21.0	74.0	-13.1	Pass
19.43	46.5		38.2		20.1	---	---	87.0	-20.4	74.0	-15.7	Pass
20.52	47.1		37.3		20.1	---	---	87.0	-19.8	74.0	-16.6	Pass
100% Load - Discharging - Neutral					---	---	---	---	---	---	---	---
0.15		58.0		48.2	21.2	---	---	93.0	-13.8	80.0	-10.6	Pass
0.24		65.0		53.3	20.6	---	---	93.0	-7.4	80.0	-6.1	Pass
0.72		56.7		49.5	20.3	---	---	87.0	-10.0	74.0	-4.2	Pass
1.38		39.3		38.4	20.1	---	---	87.0	-27.6	74.0	-15.5	Pass
19.43		49.2		39.5	20.2	---	---	87.0	-17.6	74.0	-14.3	Pass
20.00		47.1		39.3	20.2	---	---	87.0	-19.7	74.0	-14.5	Pass
0% Load - Discharging - Line					---	---	---	---	---	---	---	---
0.15	61.8		47.2		21.2	---	---	93.0	-10.1	80.0	-11.6	Pass
0.24	56.4		54.0		20.6	---	---	93.0	-16.0	80.0	-5.4	Pass
0.80	38.2		31.0		20.3	---	---	87.0	-28.5	74.0	-22.7	Pass
1.80	34.1		31.6		20.1	---	---	87.0	-32.8	74.0	-22.3	Pass
18.70	33.8		28.0		20.1	---	---	87.0	-33.1	74.0	-25.9	Pass
20.52	34.7		28.5		20.1	---	---	87.0	-32.2	74.0	-25.4	Pass
0% Load - Discharging - Neutral					---	---	---	---	---	---	---	---
0.15		51.7		36.9	21.2	---	---	93.0	-20.1	80.0	-21.9	Pass
0.24		55.3		53.8	20.6	---	---	93.0	-17.1	80.0	-5.6	Pass
0.80		36.8		31.8	20.2	---	---	87.0	-30.0	74.0	-22.0	Pass
1.80		32.6		32.6	20.1	---	---	87.0	-34.3	74.0	-21.3	Pass
18.70		36.6		23.2	20.2	---	---	87.0	-30.2	74.0	-30.6	Pass
20.52		34.6		25.1	20.2	---	---	87.0	-32.2	74.0	-28.7	Pass

Table Result: Pass by -3.90 dB ***Worst Freq:*** 0.72 MHz

Table 18

AC Mains Conducted Emissions - Output — *Curtis-Straus LLC*

Date: 11-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: Three Phase In / Single Phase Hardwired - OUTPUT
Measurement Device: Blue-Black LISN and White-Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
100% Load - Charging - Line					---	---	---	---	---	---	---	---
0.15	62.9		45.6		21.2	---	---	93.0	-8.9	80.0	-13.2	Pass
0.36	44.3		41.5		20.4	---	---	93.0	-28.4	80.0	-18.1	Pass
0.77	54.3		45.6		20.3	---	---	87.0	-12.4	74.0	-8.1	Pass
1.02	42.2		36.8		20.2	---	---	87.0	-24.7	74.0	-17.1	Pass
19.35	49.6		37.6		20.1	---	---	87.0	-17.3	74.0	-16.3	Pass
20.15	48.4		34.0		20.1	---	---	87.0	-18.5	74.0	-19.9	Pass
100% Load - Charging - Neutral					---	---	---	---	---	---	---	---
0.15		55.1		41.6	21.2	---	---	93.0	-16.7	80.0	-17.3	Pass
0.36		44.6		41.8	20.4	---	---	93.0	-28.0	80.0	-17.8	Pass
0.77		54.3		45.6	20.2	---	---	87.0	-12.5	74.0	-8.2	Pass
1.02		41.6		36.7	20.1	---	---	87.0	-25.3	74.0	-17.2	Pass
19.35		48.4		39.3	20.2	---	---	87.0	-18.4	74.0	-14.5	Pass
20.15		46.5		37.0	20.2	---	---	87.0	-20.3	74.0	-16.8	Pass
0% Load - Charging - Line					---	---	---	---	---	---	---	---
0.15	60.4		46.3		21.2	---	---	93.0	-11.4	80.0	-12.5	Pass
0.36	38.6		35.3		20.4	---	---	93.0	-34.0	80.0	-24.3	Pass
0.88	44.9		44.2		20.2	---	---	87.0	-21.9	74.0	-9.6	Pass
1.02	35.1		33.0		20.2	---	---	87.0	-31.7	74.0	-20.8	Pass
19.35	34.4		31.7		20.1	---	---	87.0	-32.5	74.0	-22.2	Pass
20.15	34.3		27.5		20.1	---	---	87.0	-32.6	74.0	-26.4	Pass
0% Load - Charging - Neutral					---	---	---	---	---	---	---	---
0.15		51.0		49.3	21.2	---	---	93.0	-20.8	80.0	-9.5	Pass
0.36		37.6		39.4	20.4	---	---	93.0	-35.0	80.0	-20.2	Pass
0.88		40.6		29.0	20.2	---	---	87.0	-26.2	74.0	-24.8	Pass
1.02		34.3		32.9	20.1	---	---	87.0	-32.6	74.0	-21.0	Pass
19.35		36.0		25.1	20.2	---	---	87.0	-30.8	74.0	-28.7	Pass
20.15		38.8		34.9	20.2	---	---	87.0	-28.0	74.0	-19.0	Pass
100% Load - Discharging - Line					---	---	---	---	---	---	---	---
0.15	62.1		48.9		21.2	---	---	93.0	-9.7	80.0	-9.9	Pass
0.24	57.4		53.1		20.6	---	---	93.0	-15.0	80.0	-6.3	Pass
0.72	62.3		50.8		20.3	---	---	87.0	-4.4	74.0	-3.0	Pass
1.39	39.8		37.4		20.2	---	---	87.0	-27.0	74.0	-16.4	Pass
19.40	46.7		39.7		20.1	---	---	87.0	-20.2	74.0	-14.2	Pass
20.25	47.3		35.9		20.1	---	---	87.0	-19.6	74.0	-18.0	Pass
100% Load - Discharging - Neutral					---	---	---	---	---	---	---	---
0.15		58.9		48.3	21.2	---	---	93.0	-12.9	80.0	-10.5	Pass
0.24		57.7		52.8	20.6	---	---	93.0	-14.7	80.0	-6.6	Pass
0.72		57.7		50.3	20.3	---	---	87.0	-9.0	74.0	-3.4	Pass
1.39		44.4		39.4	20.1	---	---	87.0	-22.5	74.0	-14.5	Pass
19.40		47.6		40.7	20.2	---	---	87.0	-19.2	74.0	-13.1	Pass
20.25		46.7		39.5	20.2	---	---	87.0	-20.1	74.0	-14.3	Pass
0% Load - Discharging - Line					---	---	---	---	---	---	---	---
0.15	62.7		47.6		21.2	---	---	93.0	-9.1	80.0	-11.3	Pass
0.24	55.2		53.5		20.6	---	---	93.0	-17.2	80.0	-5.9	Pass
0.72	40.2		31.6		20.3	---	---	87.0	-26.5	74.0	-22.1	Pass
1.80	33.1		30.7		20.1	---	---	87.0	-33.8	74.0	-23.2	Pass
19.40	35.0		24.6		20.1	---	---	87.0	-31.9	74.0	-29.3	Pass
20.25	34.1		29.7		20.1	---	---	87.0	-32.8	74.0	-24.2	Pass
0% Load - Discharging - Neutral					---	---	---	---	---	---	---	---
0.15		49.7		37.1	21.2	---	---	93.0	-22.1	80.0	-21.7	Pass
0.24		54.9		53.5	20.6	---	---	93.0	-17.5	80.0	-5.9	Pass
0.72		38.7		30.6	20.3	---	---	87.0	-28.0	74.0	-23.1	Pass
1.80		32.6		31.9	20.1	---	---	87.0	-34.3	74.0	-22.0	Pass
19.40		36.3		33.0	20.2	---	---	87.0	-30.5	74.0	-20.8	Pass
20.25		37.5		31.7	20.2	---	---	87.0	-29.3	74.0	-22.1	Pass

Table Result: Pass by -2.95 dB ***Worst Freq:*** 0.72 MHz

Table 19

AC Mains Conducted Emissions - Output — *Curtis-Straus LLC*

Date: 08-Feb-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** Maine
Notes:
Measurement Device: Blue-Black LISN and Red-Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Red

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
3 Phase In 1 Phase Out - PDU - 100% Charging - Neutral					---	---	---	---	---	---	---	---
0.18	56.6		42.0		20.9	---	---	93.0	-15.5	80.0	-17.1	Pass
0.36	54.8		43.5		20.4	---	---	93.0	-17.8	80.0	-16.1	Pass
0.48	57.4		53.2		20.4	---	---	93.0	-15.2	80.0	-6.4	Pass
4.59	41.3		33.8		20.1	---	---	87.0	-25.6	74.0	-20.1	Pass
7.56	40.1		37.5		20.2	---	---	87.0	-26.7	74.0	-16.3	Pass
9.80	47.8		42.1		20.2	---	---	87.0	-19.0	74.0	-11.7	Pass
11.50	35.6		34.7		20.2	---	---	87.0	-31.2	74.0	-19.2	Pass
3 Phase In 1 Phase Out - PDU - 100% Charging - Line					---	---	---	---	---	---	---	---
0.18		56.6		46.3	21.0	---	---	93.0	-15.4	80.0	-12.7	Pass
0.36		50.2		43.7	20.4	---	---	93.0	-22.4	80.0	-15.9	Pass
0.48		62.0		52.2	20.4	---	---	93.0	-10.6	80.0	-7.4	Pass
0.84		40.0		34.7	20.3	---	---	87.0	-26.7	74.0	-19.0	Pass
4.60		40.3		34.5	20.1	---	---	87.0	-26.6	74.0	-19.4	Pass
7.56		50.0		34.5	20.2	---	---	87.0	-16.8	74.0	-19.3	Pass
9.80		47.2		31.3	20.2	---	---	87.0	-19.6	74.0	-22.5	Pass
11.40		35.5		34.1	20.2	---	---	87.0	-31.3	74.0	-19.7	Pass
3 Phase In 1 Phase Out - PDU - 100% DisCharging - Neutra					---	---	---	---	---	---	---	---
0.24	61.2		57.0		20.6	---	---	93.0	-11.2	80.0	-2.4	Pass
0.48	63.9		55.8		20.4	---	---	93.0	-8.7	80.0	-3.8	Pass
0.84	40.0		37.9		20.3	---	---	87.0	-26.7	74.0	-15.8	Pass
9.70	35.5		29.5		20.2	---	---	87.0	-31.3	74.0	-24.4	Pass
10.00	27.3		22.0		20.2	---	---	87.0	-39.6	74.0	-31.8	Pass
2.20	35.5		32.3		20.1	---	---	87.0	-31.4	74.0	-21.6	Pass
3 Phase In 1 Phase Out - PDU - 100% DisCharging - Line					---	---	---	---	---	---	---	---
0.24		58.3		56.0	20.6	---	---	93.0	-14.1	80.0	-3.4	Pass
0.48		58.0		55.1	20.4	---	---	93.0	-14.6	80.0	-4.5	Pass
0.84		35.3		34.0	20.3	---	---	87.0	-31.4	74.0	-19.7	Pass
1.40		40.7		30.9	20.2	---	---	87.0	-26.1	74.0	-22.9	Pass
6.38		35.5		28.0	20.2	---	---	87.0	-31.3	74.0	-25.8	Pass
9.80		36.6		29.9	20.2	---	---	87.0	-30.2	74.0	-23.9	Pass
3 Phase In 1 Phase Out - PDU - 0% Charging - Neutral					---	---	---	---	---	---	---	---
0.16	44.2		36.3		21.1	---	---	93.0	-27.7	80.0	-22.6	Pass
0.48	49.4		44.5		20.4	---	---	93.0	-23.2	80.0	-15.1	Pass
0.88	34.2		32.9		20.2	---	---	87.0	-32.6	74.0	-20.9	Pass
4.60	29.7		19.2		20.1	---	---	87.0	-37.2	74.0	-34.7	Pass
9.80	42.2		35.3		20.2	---	---	87.0	-24.6	74.0	-18.5	Pass
11.37	35.4		33.7		20.2	---	---	87.0	-31.4	74.0	-20.1	Pass
3 Phase In 1 Phase Out - PDU - 0% Charging - Line					---	---	---	---	---	---	---	---
0.17		52.9		47.2	21.1	---	---	93.0	-19.0	80.0	-11.7	Pass
0.48		49.4		44.8	20.4	---	---	93.0	-23.2	80.0	-14.8	Pass
0.92		32.5		31.4	20.2	---	---	87.0	-34.3	74.0	-22.4	Pass
4.57		30.5		26.6	20.1	---	---	87.0	-36.4	74.0	-27.3	Pass
7.56		42.4		34.8	20.2	---	---	87.0	-24.4	74.0	-19.0	Pass
9.80		41.1		34.8	20.2	---	---	87.0	-25.7	74.0	-19.0	Pass
11.40		35.4		34.1	20.2	---	---	87.0	-31.4	74.0	-19.7	Pass

Table Result: Pass by -2.40 dB ***Worst Freq:*** 0.24 MHz

Table 20

AC Mains Conducted Emissions - Output — *Curtis-Straus LLC*

Date: 12-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: Three In Three Out - Hardwired - OUTPUT
Measurement Device: Black LISN, Red-Black LISN, Blue-Black LISN, White-Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall
Frequency	QP1	QP2	AV1	AV2		Limit	Margin	qp Limit	qp Margin	AVE Limit	AVE Margin	Result
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dBµV)	dB	(dBµV)	dB	(dBµV)	dB	(Pass/Fail)
100% Load - Discharging - Neutral					---	---	---	---	---	---	---	---
0.15	66.2		52.9		21.1	---	---	93.0	-5.7	80.0	-6.0	Pass
0.48	49.8		43.9		20.4	---	---	93.0	-22.8	80.0	-15.7	Pass
0.72	53.0		47.4		20.3	---	---	87.0	-13.7	74.0	-6.3	Pass
1.36	36.5		32.8		20.1	---	---	87.0	-30.4	74.0	-21.1	Pass
19.10	53.0		46.5		20.1	---	---	87.0	-13.9	74.0	-7.4	Pass
20.03	49.1		41.1		20.1	---	---	87.0	-17.8	74.0	-12.8	Pass
100% Load - Discharging - Line 1					---	---	---	---	---	---	---	---
0.15		65.6		52.6	21.2	---	---	93.0	-6.2	80.0	-6.2	Pass
0.24		58.0		52.1	20.7	---	---	93.0	-14.3	80.0	-7.2	Pass
0.72		54.8		47.1	20.3	---	---	87.0	-11.9	74.0	-6.6	Pass
1.36		40.7		26.9	20.2	---	---	87.0	-26.1	74.0	-26.9	Pass
17.70		54.2		45.7	20.2	---	---	87.0	-12.6	74.0	-8.1	Pass
20.20		45.5		39.6	20.1	---	---	87.0	-21.4	74.0	-14.3	Pass
100% Load - Discharging - Line 2					---	---	---	---	---	---	---	---
0.15	66.8		53.1		21.2	---	---	93.0	-5.0	80.0	-5.8	Pass
0.24	56.3		50.1		20.7	---	---	93.0	-16.0	80.0	-9.3	Pass
0.72	53.4		46.6		20.3	---	---	87.0	-13.4	74.0	-7.1	Pass
1.36	39.1		36.2		20.2	---	---	87.0	-27.7	74.0	-17.6	Pass
17.50	52.7		46.1		20.2	---	---	87.0	-14.1	74.0	-7.7	Pass
20.65	47.3		40.7		20.1	---	---	87.0	-19.6	74.0	-13.2	Pass
100% Load - Discharging - Line 3					---	---	---	---	---	---	---	---
0.15		57.4		49.1	21.2	---	---	93.0	-14.4	80.0	-9.7	Pass
0.48		49.1		44.1	20.4	---	---	93.0	-23.5	80.0	-15.5	Pass
0.72		53.2		46.3	20.3	---	---	87.0	-13.5	74.0	-7.4	Pass
1.36		37.7		32.7	20.1	---	---	87.0	-29.2	74.0	-21.2	Pass
19.65		49.1		39.9	20.2	---	---	87.0	-17.8	74.0	-13.9	Pass
20.13		46.0		39.1	20.2	---	---	87.0	-20.8	74.0	-14.7	Pass
0% Load - Discharging - Neutral					---	---	---	---	---	---	---	---
0.15	63.5		52.4		21.1	---	---	93.0	-8.4	80.0	-6.5	Pass
0.24	55.2		51.6		20.6	---	---	93.0	-17.2	80.0	-7.8	Pass
0.76	38.8		30.3		20.2	---	---	87.0	-28.0	74.0	-23.5	Pass
9.70	27.2		24.4		20.2	---	---	87.0	-39.6	74.0	-29.4	Pass
19.20	41.0		30.3		20.1	---	---	87.0	-25.9	74.0	-23.7	Pass
20.25	35.9		27.8		20.1	---	---	87.0	-31.0	74.0	-26.2	Pass
0% Load - Discharging - Line 1					---	---	---	---	---	---	---	---
0.15		65.2		52.5	21.2	---	---	93.0	-6.6	80.0	-6.3	Pass
0.24		55.4		51.6	20.7	---	---	93.0	-16.9	80.0	-7.7	Pass
0.76		38.8		30.6	20.3	---	---	87.0	-27.9	74.0	-23.1	Pass
8.60		22.0		18.3	20.2	---	---	87.0	-44.8	74.0	-35.5	Pass
17.25		43.2		35.4	20.2	---	---	87.0	-23.6	74.0	-18.5	Pass
20.30		31.6		23.9	20.1	---	---	87.0	-35.3	74.0	-30.0	Pass
0% Load - Discharging - Line 2					---	---	---	---	---	---	---	---
0.15	64.3		52.5		21.2	---	---	93.0	-7.5	80.0	-6.3	Pass
0.24	55.0		51.6		20.7	---	---	93.0	-17.3	80.0	-7.7	Pass
0.76	37.2		30.5		20.3	---	---	87.0	-29.5	74.0	-23.2	Pass
1.80	26.2		25.2		20.1	---	---	87.0	-40.7	74.0	-28.7	Pass
17.60	42.4		34.6		20.2	---	---	87.0	-24.4	74.0	-19.2	Pass
21.06	30.6		22.9		20.2	---	---	87.0	-36.2	74.0	-30.9	Pass
0% Load - Discharging - Line 3					---	---	---	---	---	---	---	---
0.15		56.6		41.6	21.2	---	---	93.0	-15.2	80.0	-17.2	Pass
0.24		55.0		51.8	20.7	---	---	93.0	-17.3	80.0	-7.5	Pass
0.76		37.7		30.7	20.2	---	---	87.0	-29.1	74.0	-23.1	Pass
1.80		23.5		15.0	20.1	---	---	87.0	-43.4	74.0	-38.9	Pass
19.50		38.1		31.7	20.2	---	---	87.0	-28.7	74.0	-22.1	Pass
20.35		34.2		25.4	20.2	---	---	87.0	-32.6	74.0	-28.4	Pass

Table Result: Pass by -5.00 dB ***Worst Freq:*** 0.15 MHz

Table 21

AC Mains Conducted Emissions - Output — *Curtis-Straus LLC*

Date: 12-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: Tuyen Truong **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMI2
Notes: Three In Three Out - Hardwired - OUTPUT
Measurement Device: Black LISN, Red-Black LISN, Blue-Black LISN, White-Black LISN
Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	---		EN55022 - Class A and IEC62040-2 - Class A				Overall Result
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	(Pass/Fail)
100% Load - Charging - Neutral					---	---	---	---	---	---	---	---
0.15	66.3		52.5		21.1	---	---	93.0	-5.6	80.0	-6.4	Pass
0.32	48.4		40.4		20.4	---	---	93.0	-24.2	80.0	-19.3	Pass
0.88	45.8		41.5		20.2	---	---	87.0	-21.0	74.0	-12.3	Pass
1.24	36.6		34.2		20.1	---	---	87.0	-30.3	74.0	-19.7	Pass
17.85	52.0		46.1		20.2	---	---	87.0	-14.8	74.0	-7.7	Pass
20.23	51.1		42.4		20.1	---	---	87.0	-15.8	74.0	-11.5	Pass
100% Load - Charging - Line 1					---	---	---	---	---	---	---	---
0.15		66.5		52.2	21.2	---	---	93.0	-5.3	80.0	-6.6	Pass
0.32		44.7		40.2	20.4	---	---	93.0	-28.0	80.0	-19.4	Pass
0.88		45.7		38.9	20.2	---	---	87.0	-21.1	74.0	-14.9	Pass
1.24		37.5		32.5	20.2	---	---	87.0	-29.3	74.0	-21.3	Pass
17.85		55.3		45.4	20.2	---	---	87.0	-11.5	74.0	-8.4	Pass
20.23		46.1		37.7	20.1	---	---	87.0	-20.9	74.0	-16.2	Pass
100% Load - Charging - Line 2					---	---	---	---	---	---	---	---
0.15	65.2		53.7		21.2	---	---	93.0	-6.6	80.0	-5.1	Pass
0.32	46.6		39.4		20.5	---	---	93.0	-25.9	80.0	-20.1	Pass
0.88	43.7		41.2		20.2	---	---	87.0	-23.1	74.0	-12.6	Pass
1.24	36.1		34.1		20.2	---	---	87.0	-30.7	74.0	-19.7	Pass
17.85	51.3		46.2		20.1	---	---	87.0	-15.6	74.0	-7.7	Pass
20.23	46.9		40.3		20.1	---	---	87.0	-20.0	74.0	-13.6	Pass
100% Load - Charging - Line 3					---	---	---	---	---	---	---	---
0.15		57.6		41.0	21.2	---	---	93.0	-14.2	80.0	-17.8	Pass
0.32		47.4		40.3	20.5	---	---	93.0	-25.1	80.0	-19.2	Pass
0.92		43.8		41.5	20.1	---	---	87.0	-23.1	74.0	-12.4	Pass
1.24		38.8		30.5	20.1	---	---	87.0	-28.2	74.0	-23.4	Pass
19.50		46.0		38.1	20.2	---	---	87.0	-20.8	74.0	-15.8	Pass
20.23		45.7		37.0	20.2	---	---	87.0	-21.1	74.0	-16.8	Pass
0% Load - Charging - Neutral					---	---	---	---	---	---	---	---
0.15	64.4		52.1		21.1	---	---	93.0	-7.5	80.0	-6.8	Pass
0.44	39.1		34.3		20.4	---	---	93.0	-33.5	80.0	-25.3	Pass
0.92	43.0		42.2		20.1	---	---	87.0	-23.9	74.0	-11.7	Pass
1.02	32.6		28.9		20.1	---	---	87.0	-34.3	74.0	-25.0	Pass
18.80	41.3		32.1		20.1	---	---	87.0	-25.6	74.0	-21.8	Pass
20.15	37.6		28.5		20.1	---	---	87.0	-29.3	74.0	-25.4	Pass
0% Load - Charging - Line 1					---	---	---	---	---	---	---	---
0.15		65.0		52.0	21.2	---	---	93.0	-6.8	80.0	-6.8	Pass
0.77		41.7		40.5	20.3	---	---	87.0	-25.0	74.0	-13.2	Pass
0.92		41.1		40.0	20.2	---	---	87.0	-25.7	74.0	-13.8	Pass
1.02		36.9		36.2	20.2	---	---	87.0	-29.9	74.0	-17.6	Pass
17.15		44.8		35.2	20.2	---	---	87.0	-22.0	74.0	-18.6	Pass
20.15		32.3		23.8	20.1	---	---	87.0	-34.6	74.0	-30.1	Pass
0% Load - Charging - Line 2					---	---	---	---	---	---	---	---
0.15	64.4		52.0		21.2	---	---	93.0	-7.4	80.0	-6.8	Pass
0.28	54.8		38.3		20.5	---	---	93.0	-17.7	80.0	-21.2	Pass
0.80	31.4		29.1		20.3	---	---	87.0	-35.3	74.0	-24.6	Pass
5.25	23.0		18.2		20.1	---	---	87.0	-43.9	74.0	-35.7	Pass
17.15	41.6		33.7		20.2	---	---	87.0	-25.2	74.0	-20.1	Pass
20.15	35.3		26.4		20.1	---	---	87.0	-31.6	74.0	-27.5	Pass
0% Load - Charging - Line 3					---	---	---	---	---	---	---	---
0.15		58.8		43.2	21.2	---	---	93.0	-13.0	80.0	-15.6	Pass
0.28		41.6		38.6	20.5	---	---	93.0	-30.9	80.0	-21.0	Pass
0.58		32.9		28.9	20.3	---	---	87.0	-33.8	74.0	-24.8	Pass
1.20		23.6		14.6	20.1	---	---	87.0	-43.3	74.0	-39.3	Pass
18.46		38.0		34.3	20.2	---	---	87.0	-28.8	74.0	-19.5	Pass
21.75		31.8		29.5	20.2	---	---	87.0	-35.0	74.0	-24.3	Pass

Table Result: Pass by -5.10 dB ***Worst Freq:*** 0.15 MHz

Table 22

Telco Conducted Emissions - Voltage — *Curtis-Straus LLC*

Date: 24-Jan-07 **Company:** APC Corporation **Work Order:** H0023
Engineer: David Harris **EUT Desc:** SURT20KRMXLI with SURT192RMXLBP2 **Test Site:** EMC 4
Notes: 3 Phase In 3 Phase Out - Hardwired Configuration - Ethernet port (RJ45) on the Webcard of EUT
Measurement Device: Telco ISN
Range: 0.15-30MHz **Spectrum Analyzer:** Black

	Q.P. Readings		Ave. Readings		Impedance Factor	---		022:98 telco voltage (A)		022:98 telco voltage (A)		Overall
Frequency (MHz)	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)	(dB)	Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	Result (Pass/Fail)
0.21	41.2		40.7		9.8	---	---	94.2	-43.2	81.2	-30.7	Pass
2.12	55.9		49.8		9.7	---	---	87.0	-21.4	74.0	-14.5	Pass
5.25	46.7		43.2		9.7	---	---	87.0	-30.6	74.0	-21.1	Pass
9.39	47.3		49.2		9.7	---	---	87.0	-30.0	74.0	-15.1	Pass
16.71	53.4		45.4		9.7	---	---	87.0	-23.9	74.0	-18.9	Pass
23.12	54.1		52.2		9.7	---	---	87.0	-23.2	74.0	-12.1	Pass

Table Result: Pass by -12.14 dB ***Worst Freq:*** 23.12 MHz

Table 23

SURGE DATA SHEET

Work Order: H0023
Date: 1/15/2007, 1/18/2007
Engineer: Nate Sanford, Edward Breen
EUT: SURT20KRMXLI with SURT192RMXLBP2
Company: APC Corporation

Modifications since start date:
None

Modifications this test:
See Modification Required for Compliance Section

Testing Location: 527 Great Road - Main Building, Littleton, MA 01460

Performance Criteria: B

Test Equipment:
CDI Universal Surge Generator M5

Maximum Test Parameters: *Input and Output AC Power Ports*

Open Circuit Waveshape:	1.2/50	Tr/Th µs
Line-to-earth:	2	kV (charge voltage)
Line-to-line:	1	kV (charge voltage)

Repitition Rate: 1 surge per minute
Reps/Polarity/Phase Angle: 5 (maximum test level)
1 (lower test levels)

EUT Operating Voltage/Frequency: 230 VAC 50 Hz

Atmospheric Conditions:

	Temp	Humidity	Pressure
15-Jan	23.2°C	23%	1013.7mbar
18-Jan	23.8°C	11%	1030.9mbar

Test Points: 3 phase In 3 Phase Out Configuration

AC mains:	Test Level	Online Mode	Bypass Mode	Phase Angle
Line 1 - Ground	±0.5kV	Pass	Pass	None
Line 1 - Ground	±1kV	Pass	Pass	None
Line 1 - Ground	±2kV	Pass	Pass	None
Line 2 - Ground	±0.5kV	Pass	Pass	None
Line 2 - Ground	±1kV	Pass	Pass	None
Line 2 - Ground	±2kV	Pass	Pass	None
Line 3 - Ground	±0.5kV	Pass	Pass	None
Line 3 - Ground	±1kV	Pass	Pass	None
Line 3 - Ground	±2kV	Pass	Pass	None
Neutral - Ground	±0.5kV	Pass	Pass	None
Neutral - Ground	±1kV	Pass	Pass	None
Neutral - Ground	±2kV	Pass	Pass	None
Line 1 - Neutral	±0.5kV	Pass	Pass	None
Line 1 - Neutral	±1kV	Pass	Pass	None
Line 2 - Neutral	±0.5kV	Pass	Pass	None
Line 2 - Neutral	±1kV	Pass	Pass	None
Line 3 - Neutral	±0.5kV	Pass	Pass	None
Line 3 - Neutral	±1kV	Pass	Pass	None

Table 24

EFT DATA SHEET			
Work Order:	H0023		
Date:	16-Jan-07	19-Jan-07	
Engineer:	Tuyen Truong	Nate Sanford	
EUT:	SURT20KRMXLI with SURT192RMXLBP2		
Company:	APC Corporation		
Modifications since start date:			
See Modification Required for Compliance Section			
Modifications this test:			
none			
Testing Location:	527 Great Road - Main Building, Littleton, MA 01460		
Performance Criteria:	B		
Test Equipment:	BEST EMC Test Instrument Package		Red
Maximum Test Parameters:		±1 kV-AC	±0.5 kV-Cables
EUT Operating Voltage/Frequency:	230 Vac 50 Hz		
Atmospheric Conditions:			
Temp: 21.8°C	**Humidity:** 22%	**Pressure:** 1008.8mbar	
Test Points:		**Pass/Fail**	**Comments:**
Test Configuration:	3 Phase In 3 Phase Out - Hardwired		
AC mains -L-GND		Pass	
AC mains -N-GND		Pass	
AC mains -PE-GND		Pass	
Cables:			
Ethernet		Pass	
Alarm		Pass	
Temp/humidity		Pass	

Table 25

RFI DATA SHEET

Work Order: H0023
Date: 1/17/2007, 1/18/2007
Engineer: Edward Breen
EUT: SURT20KRMXLI with SURT192RMXLBP2
Company: APC Corporation

Modifications since start date:
none

Modifications this test:
none

Testing Location:	527 Great Road - Main Building, Littleton, MA 01460
Performance Criteria:	A
Frequency Range:	27 - 1000 MHz
Maximum Test Parameters:	10 V/m
Modulation:	80% AM @ 1kHz
EUT Cycle Time:	Continuous
Dwell Frequencies:	80, 120, 160, 230, 434, 460, 600, 863, 900MHz
Clock Frequencies:	50 MHz
EUT Operating Voltage/Frequency:	230 VAC 50 Hz

Test Equipment Used:

Amplifier:	Red, Brown	***Signal Generator:***	Blue
Antenna:	Yellow-black	***Field Probe:***	Blue

Atmospheric Conditions:

	Temp	Humidity	Pressure
17-Jan	23.6°C	11%	1032.3 mB
18-Jan	23.8°C	11%	1030.9 mB

Results:

Test Configuration: 3 Phase In 3 Phase Out - Hardwired

	Front	Right	Back	Left
Horizontal	Pass	Pass	Pass	Pass
Vertical	Pass	Pass	Pass	Pass

Table 26

CRFI DATA SHEET

Work Order: H0023
Date: 16-Jan-07
Engineer: Tuyen Truong
EUT: SURT20KRMXLI with SURT192RMXLBP2
Company: APC Corporation

Modifications since start date:
none

Modifications this test:
none

Testing Location: 527 Great Road - Main Building, Littleton, MA 01460

Performance Criteria: A

Test Equipment:

Sig Gen:	Orange	**Amp:**	Black	**CDN:**	WhiteBrown
		Resistor Network:	Green	**Injection Clamp:**	Red

EUT Operating Voltage/Frequency: 230 Vac 50 Hz

Maximum Test Parameters:

Signal Level: 10Vrms
Modulation: 80% AM @ 1kHz sine
Frequency Range: 0.15-80MHz
EUT Cycle Time: Continuous
Dwell Frequencies: 0.2, 1.0, 7.1, 13.56, 21, 27.12, 40.68MHz
Clock Frequencies: 12, 16, 24, 25 and 50 MHz

Atmospheric Conditions:

Temp: 21.8°C **Humidity:** 22% **Pressure:** 1008.8mbar

Test Points:	Pass/Fail	Comments:
Test Configuration:	3 Phase In 3 Phase Out - Hardwired	
AC In	Pass	
AC Out	Pass	
Ethernet	Pass	
Alarm	Pass	
Temp/humidity	Pass	

Table 27

ESD DATA SHEET

Work Order: H0023
Date: 19-Jan-07
Engineer: Nate Sanford
EUT: SURT20KRMXLI with SURT192RMXLBP2
Company: APC Corporation

Modifications since start date:
See Modifications section

Modifications this test:

Testing Location: 527 Great Road - Main Building, Littleton, MA 01460

Performance Criteria: B

Test Equipment: Schaffner NSG 435 **Gun:** Red

Maximum Test Parameters: ±8 kV-air ±4 kV-contact

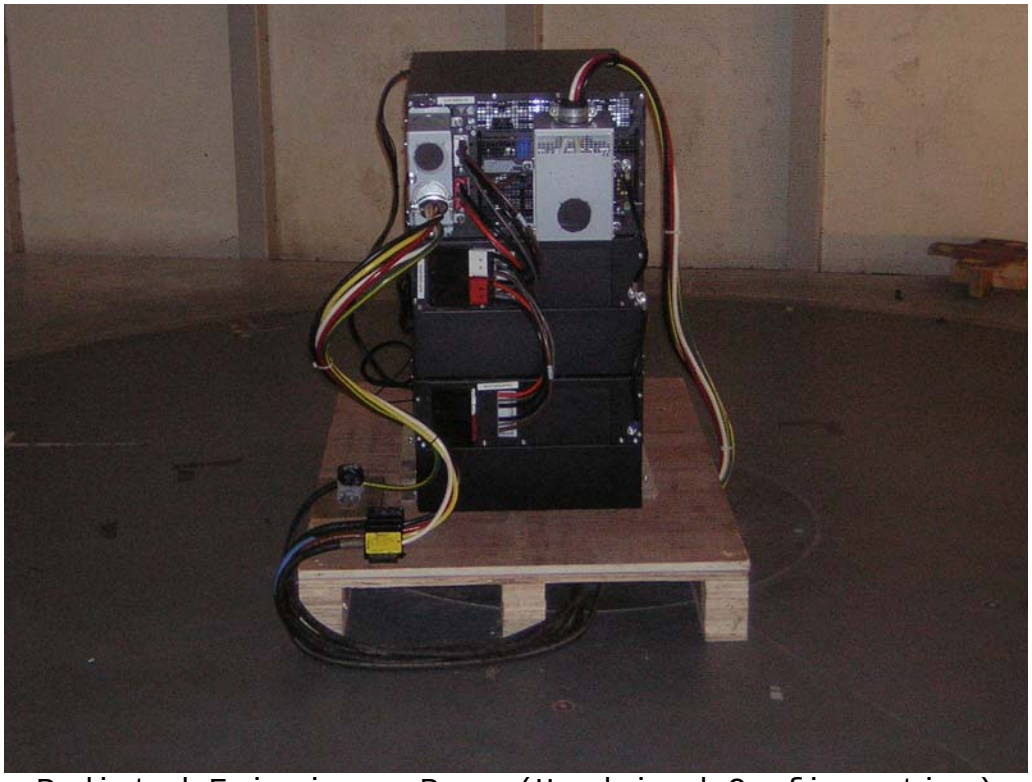
EUT Operating Voltage/Frequency: 230 Vac 50 Hz

Atmospheric Conditions:
Temp: 23.5°C **Humidity:** 20% **Pressure:** 998.6 mbar

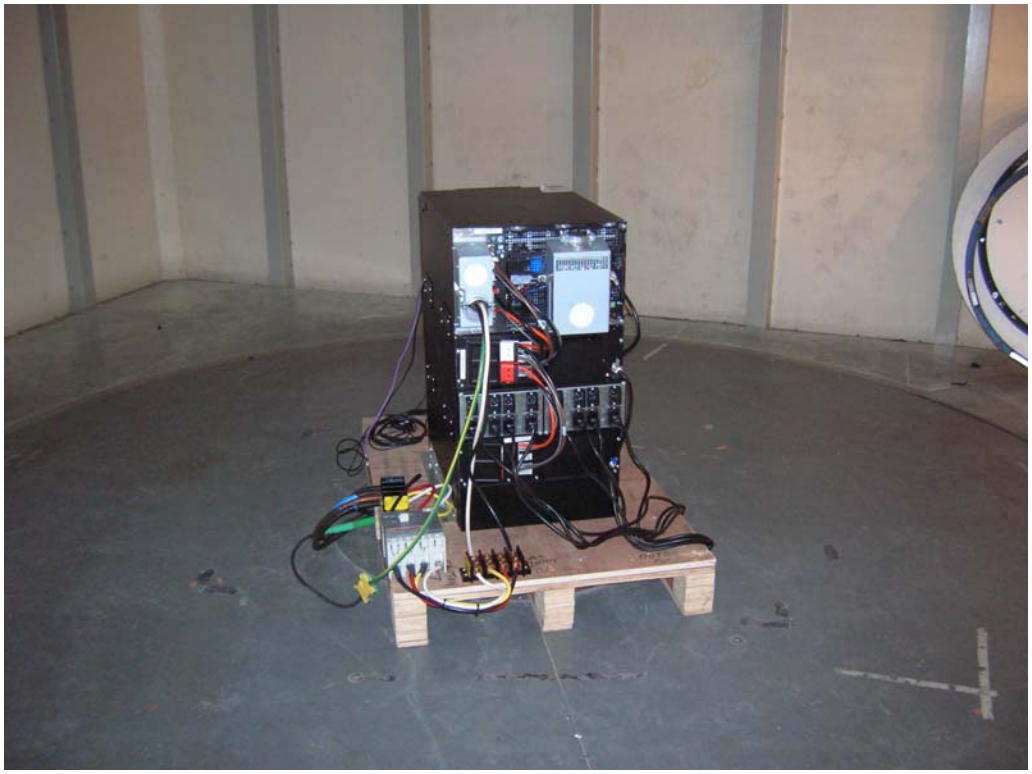
Test Points:	Pass/Fail	Comments:
Test Configuration:	3 Phase In 3 Phase Out - Hardwired	
Horizontal Coupling Plane	Pass	±2kV, ±4kV
Vertical Coupling Plane	Pass	±2kV, ±4kV
Contact Discharge Test Points	Pass	±2kV, ±4kV
Front: chassis screw, enet shell, web card chassis, metal around reset		
Rear: chassis, screws, metal around reset input module case, output module case		
Left, Right and Top: chassis, screws.		
Air Discharge Test Points	Pass	±2kV, ±4kV, ±8kV
Powerview button, Powerview LCD		

Test Configuration Photographs

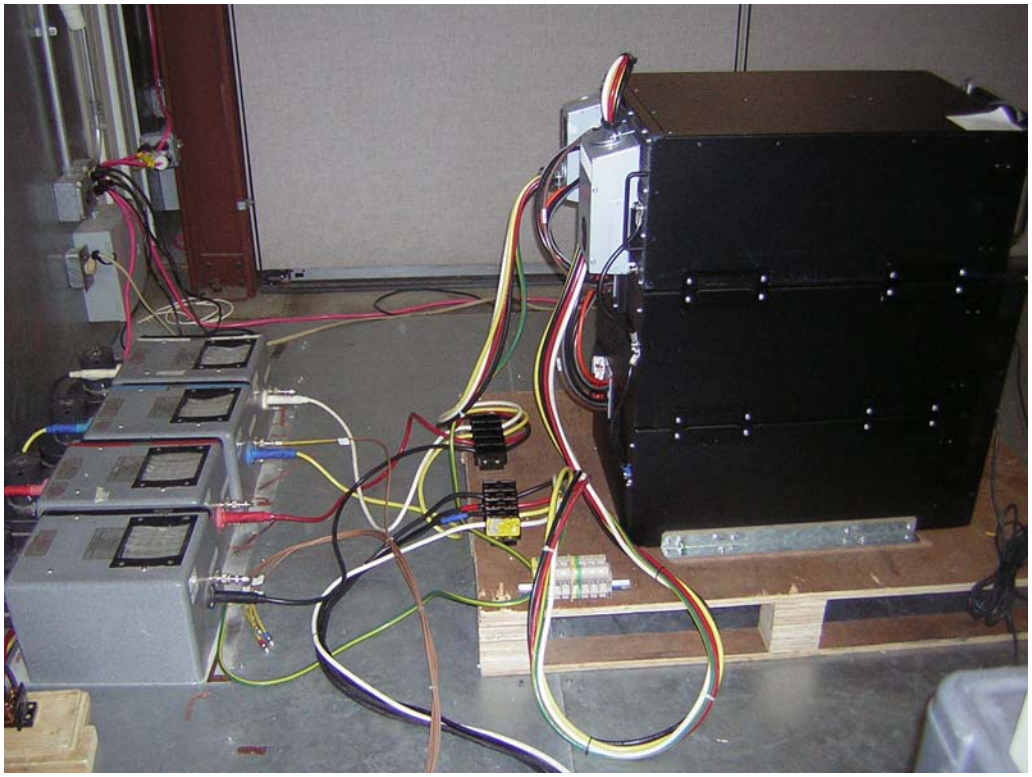
Radiated Emission – Front



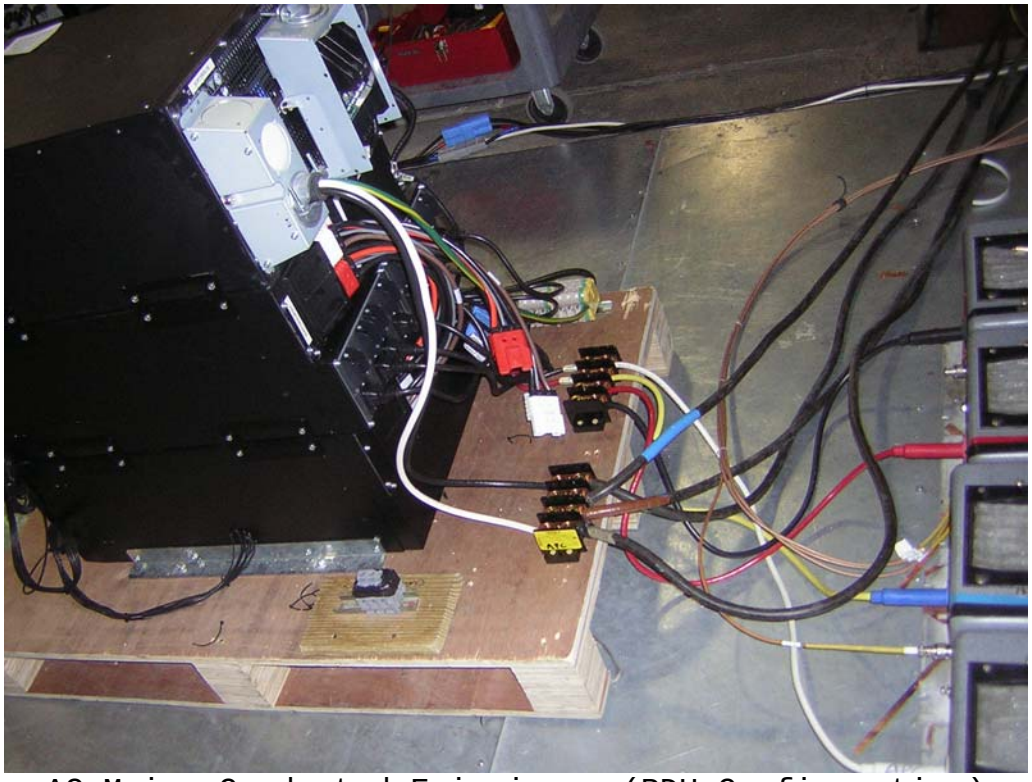
Radiated Emission – Rear (Hardwired Configuration)



Radiated Emission - Rear (PDU Configuration)

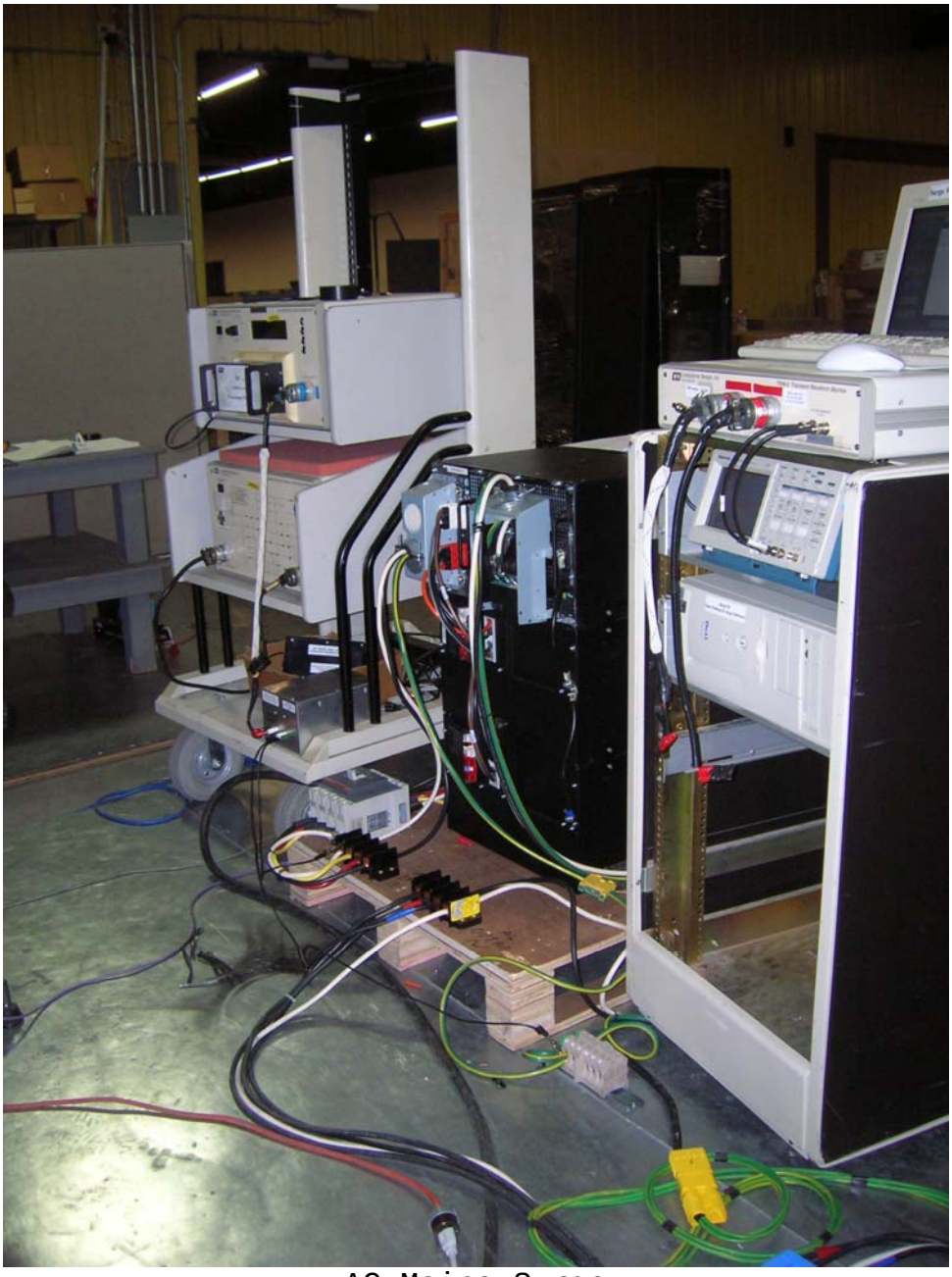


AC Mains Conducted Emission – (Hardwired Configuration)

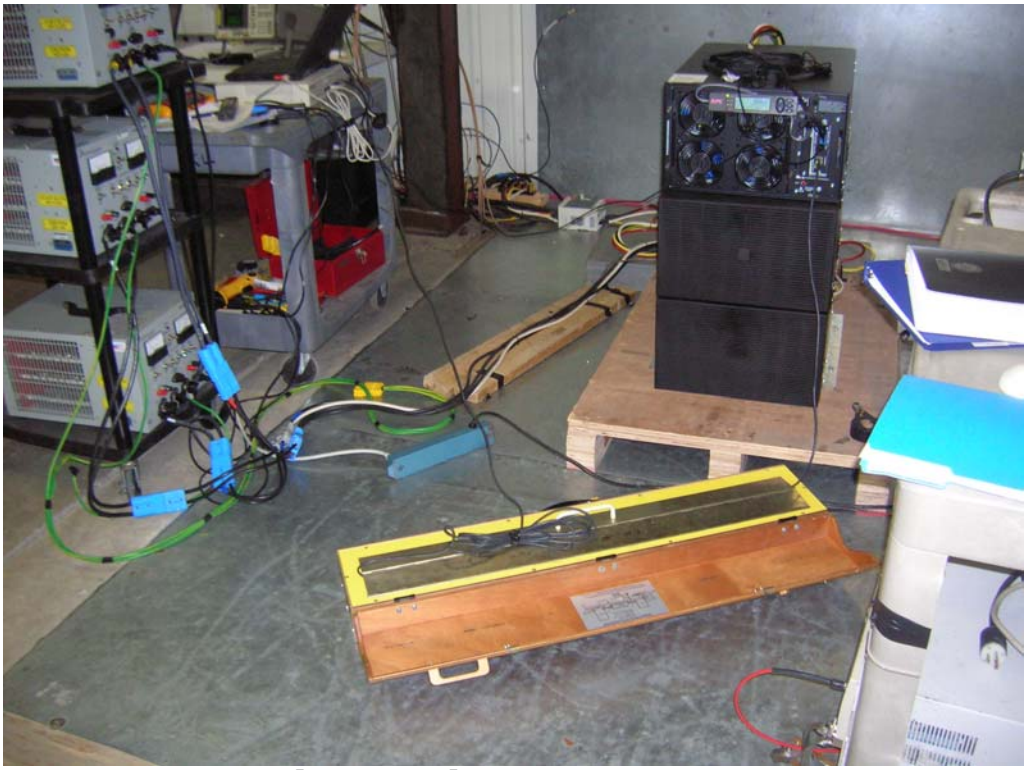


AC Mains Conducted Emission – (PDU Configuration)

Telco Conducted Emission

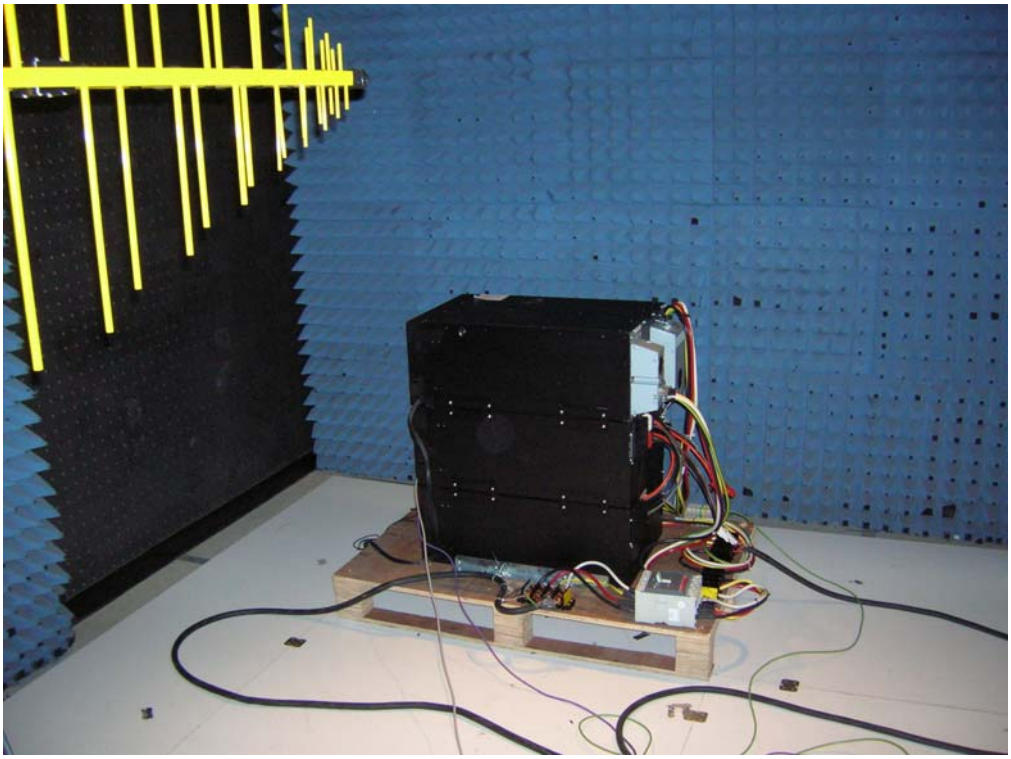


AC Mains Surge



Electrical Fast Transient

Electrostatic Discharge



Radiated RF Immunity

Conducted RF Immunity

Test Descriptions

Radiated Emissions Testing Overview

REV 22-SEP-05

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). 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.

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+	49.5	43.5	N/A	N/A	1000+

At the transitions, the lower limit applies.
Simple inverse scaling utilized to convert limits where appropriate.

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+	60	54	N/A	N/A	1000+

At the transitions, the lower limit applies.
Simple inverse scaling utilized to convert limits where appropriate.

For CISPR and EU standards measurements are usually made over the frequency range of 30 MHz to 1GHz. Deviations are noted in the test report. For the FCC, 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.

FCC 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)
Below 1.705	30 (No radiated measurements)
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5^{th} harmonic of the highest frequency or 40 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:

Field Strength (dBuV/m) = Voltage Reading (dBuV) - Preamp Gain (dB) + Cable Loss (dB) + 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.

Standard Uncertainty per NIST Technical Note 1297 1994 for this test is estimated to be 2.8dB. This test method is covered by our A2LA accreditation.

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 (dBµV)		
Frequency (MHz)	Quasi-Peak	Average
0.15 - 0.5	79	66
0.5 - 30	73	60
Line Conducted Emissions Limits: Class B (dBµV)		
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.

Standard Uncertainty per NIST Technical Note 1297 1994 for this test is estimated to be 2dB.

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.

EN55022:1998 Telco Cable Conducted Current Emissions Testing Overview

REV 3-May-00

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.

Class A limits of conducted common mode disturbance at telecommunication ports

Frequency Range MHz	Voltage Limits dB(μV)		Current Limits dB(μA)	
	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

Class B limits of conducted common mode disturbance at telecommunication ports

Frequency Range MHz	Voltage Limits dB(μV)		Current Limits dB(μA)	
	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 150Ω 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 150Ω 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.

Radiated RF Immunity Testing Overview

REV 15-JUN-04

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 a field strength. For EN 61000-4-3:, the enclosure is calibrated without the EUT present and the levels required to produce a test field strength are recorded in a computerized table. The test levels are then played back from the computer to produce 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.

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.

Standard Uncertainty per NIST Technical Note 1297 1994 for this test is estimated to be 2dB.

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 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 hexaflorine 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.

Standard Uncertainty per NIST Technical Note 1297 1994 for this test is estimated to be 6%.

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 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.

Standard Uncertainty per NIST Technical Note 1297 1994 for this test is estimated to be 12%.

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 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 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.

Standard Uncertainty per NIST Technical Note 1297 1994 for this test is estimated to be 1.5dB.

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.

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 µS and a pulse width of 50 µS (open circuit). The short circuit waveform is an 8 x 20 µS 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 360º. 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 µS lightning surges. In this case, however, the peak voltage is usually limited to 500 volts in both common and differential mode.

Standard Uncertainty per NIST Technical Note 1297 1994 is estimated to be 12% for this test.

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.

Test Equipment Used

REV. 03-JAN-2007

SPECTRUM ANALYZERS / RECEIVERS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
RED	9kHz-1.8GHz	8591E	Agilent	3441A03559	00024	I	Out of Cal
WHITE	9kHz-22GHz	8593E	Agilent	3547U01252	00022	I	06-OCT-2007
BLUE	9kHz-1.8GHz	8591E	Agilent	3223A00227	00070	I	18-DEC-2007
YELLOW	9kHz-2.9GHz	8594E	Agilent	3523A01958	00100	I	05-JUN-2007
GREEN	9kHz-26.5GHz	8593E	Agilent	3829A03618	00143	I	05-SEP-2007
BLACK	9kHz-12.8GHz	8596E	Agilent	3710A00944	00337	I	08-DEC-2007
TELECOM 3585A	20Hz-40.0MHz	3585A	Agilent	2504A05219	00030	I	07-FEB-2007
TELECOM 3585A	20Hz-40.0MHz	3585A	Agilent	1750A03418	00558	1	23-MAY-2007
TELECOM 3585A	20Hz-40.0MHz	3585A	Agilent	1750A02762	01067	I	01-MAR-2007
ORANGE	9kHz-26.5GHz	E4407B	Agilent	US39440975	00394	I	18-DEC-2007
BROWN (RENTAL)	9kHz-26.5GHz	E4407B	Agilent	SG44210511	Rental	1	05-JAN-2007
EMI TEST RECEIVER	20-1000MHz	ESVS30	R&S	827957/001	01098	I	27-OCT-2008

LISNs/MEASUREMENT PROBES	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
RED	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	956348	00753	II	05-MAY-2007
BLUE (DC)	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	956349	00752	II	05-MAY-2007
YELLOW-BLACK	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	984735	00248	II	05-MAY-2007
ORANGE	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	903707	00754	II	05-MAY-2007
GOLD (DC)	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	984734	00247	II	05-MAY-2007
BROWN	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	0411656	00986	II	05-MAY-2007
GREEN	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	0411657	00987	II	08-MAY-2007
YELLOW	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	0411658	1080	II	05-MAY-2007
WHITE-BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972019	00678	II	05-MAY-2007
BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972017	00675	II	05-MAY-2007
RED-BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972016	00677	II	05-MAY-2007
BLUE-BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972018	00676	II	05-MAY-2007
BLUE MONITORING PROBE	0.01-150MHz	91550-2	TEGAM	12350	00807	I	26-MAY-2007
YELLOW MONITORING PROBE	0.01-150MHz	91550-2	ETS	50972	00493	I	23-JAN-2008
GREEN CURRENT TRANSFORMER	40Hz-20MHz	150	PEARSON	10226	00793	I	07-APR-2007
BLUE CISPR LINE PROBE	150kHz-30MHz	N/A	C-S	N/A	00805	II	08-JUN-2007
BLACK CISPR LINE PROBE	150kHz-30MHz	N/A	C-S	N/A	NONE	II	08-JUN-2007
CISPR TELCO VOLTAGE PROBE	10kHz-30MHz	CS A/C-10	C-S	CS01	00296	II	17-NOV-2007
CISPR 22 TELCO ISN	9kHz-30MHz	FCC-TLISN-T4	FISCHER	20115	00746	I	15-NOV-2007

OPEN AREA TEST SITES (OATS)	FCC CODE	IC CODE	VCCI CODE	CAT	CALIBRATION DUE
SITE F	93448	IC 2762A-1	R-1688	II	04-APR-2007
SITE T	93448	IC 2762A-2	R-905	II	14-AUG-2007
SITE A	93448	IC 2762-A	R-903	II	13-AUG-2007
SITE M	93448	IC 2762-M	R-904	II	19-MAR-2007
SITE J	93448	IC 2762A-3	R-2377	II	11-APR-2008

CONDUCTED TEST SITES (MAINS / TELCO)	FCC CODE	IC CODE	VCCI CODE	CAT	CALIBRATION DUE
EMI 1	93448	N/A	C-1801, T-268	III	NA
EMI 2	93448	N/A	C-1802, T-269	III	NA
EMI 3	93448	N/A	C-1803, T-270	III	NA

MIXERS/DIPLEXERS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
MIXER / HORN	26.5-40 GHz	11970A/28-442-6	HP/ATM	2332A01695/A046903-01	1087	I	23-AUG-2007
MIXER / HORN	26.5-40 GHz	11970A/28-442-6	HP/ATM	3003A07825/A046903-01	1086	I	19-SEP-2007
MIXER / HORN	40-60 GHz	M19HW/A	OML	U30110-1	00821	I	02-MAR-2007
MIXER	33-50 GHz	11970Q	HP	3003A03155	00104	I	08-NOV-2007
MIXER / HORN	50-75 GHz	11970V /QWH-VPRROO	HP/QUINSTAR	2521A01197/8794001	1179	I	15-NOV-2007
MIXER	75-110 GHz	11970W	HP	2521A01334	00105	I	22-NOV-2007
MIXER / HORN	60-90 GHz	M12HW/A	OML	E30110-1	00822	I	03-MAR-2007
MIXER / HORN	90-140 GHz	MO8HW/A	OML	F21206-1	00811	I	03-MAR-2007
MIXER / HORN	140-220 GHz	MO5HW/A	OML	G21206-1	00812	II	
DIPLEXER	40-220 GHz	DPL.26	OML	N/A	00813	I	03-MAR-2007

ABSORBING CLAMPS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
FISCHER CLAMP	30-1000MHZ	F-201-23MM	FISCHER	10	00081	I	20-JAN-2008

HARMONIC & FLICKER ANALYZER	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
HFTS	HP6842A	HP	3531A-00169	00738	II	30-DEC-2007
10001I/2 AC POWER SYSTEM	(2) 500I	CALIFORNIA INSTRUMENTS	HK53687/HK53688	00376	II	09-JAN-2008

PREAMPS / ATTENUATORS / FILTERS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
RED	0.10-2000MHZ	ZFL-1000-LN	C-S	N/A	00798	II	28-JUL-2007
BLUE	0.01-2000MHZ	ZFL-1000-LN	C-S	N/A	00759	II	20-JUL-2007
BLUE-BLACK	0.01-2000MHZ	ZFL-1000-LN	C-S	N/A	00800	II	04-JAN-2007
GREEN	0.01-2000MHZ	ZFL-1000-LN	C-S	N/A	00802	II	21-DEC-2007
BLACK	0.01-2000MHZ	ZFL-1000-LN	C-S	N/A	00799	II	20-JUL-2007
ORANGE	0.01-2000MHZ	ZFL-1000-LN	C-S	N/A	00765	II	21-DEC-2007
WHITE	1-20GHZ	SMC-12A	C-S	426643	00760	II	22-JUL-2007
BROWN	1-20GHZ	PM2-38-218-4R5-17-15-SFF	C-S	PL1655	1132	II	14-APR-2007
YELLOW-BLACK	1-20GHZ	SMC-12A	C-S	535055	00801	II	22-JUL-2007
RED-GREEN	1-20GHZ	PM2-38-218-4R5-17-15-SFF	C-S			II	14-AUG-2007
HF (YELLOW)	18-26.5GHZ	AFS4-18002650-60-8P-4	C-S	467559	00758	II	23-AUG-2007
HIGH PASS FILTER	1-18 GHZ	SPA-F-55204	K&L	36	00817	II	05-JAN-2008
LOW PASS FILTER	1-9 GHZ	11SL10-4100/X4400-O/O	K&L	4	00816	II	05-JAN-2008
HF 20DB 50W ATTENUATOR	0.03-20 GHZ	PE 7019-20	PASTERNACK	01	00791	II	10-MAY-2007
HF 30DB 50W ATTENUATOR	0.03-20 GHZ	PE 7019-30	PASTERNACK	02	1168	II	10-MAY-2007
40DB 100W ATTENUATOR	0.09-4000MHZ	BW-40N100W+	MINI-CIRCUITS	V N014900638	1231	II	08-NOV-2007
LOW FREQ LPF	10-100KHZ	L200K1G1	MICROWAVE CIRCUITS	4460-01 DC0432	1019	II	OUT OF SERVICE
LOW FREQ LPF	10-100KHZ	L200K1G1	MICROWAVE CIRCUITS	4777-01 DC0434	1088	II	OUT OF SERVICE

ANTENNAS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
GREEN BILOG	30-2000MHZ	CBL6112B	CHASE	2742	00620	II	13-JAN-2008
GREEN-BLACK BILOG	30-2000MHZ	CBL6112B	CHASE	2412	00127	II	13-JAN-2008
GREEN-RED BILOG	30-2000MHZ	CBL6112B	CHASE	2435	00990	I	12-APR-2008
BLUE BILOG	30-1000MHZ	3143	EMCO	1271	00803	II	06-MAY-2007
GRAY BILOG	20-2000MHZ	3141	EMCO	9703-1038	00066	II	06-MAY-2007(EMI) / 30-JUN-2007(RFI2)
YELLOW-BLACK BILOG	20-2000MHZ	CBL6140A	CHASE	1112	00126	II	06-MAY-2007(EMI) / 01-MAY-2007(RFI)
RED-WHITE BILOG	30-2000MHZ	JB1	SUNOL	A091604-1	01105	I	07-NOV-2008
RED-BLACK BILOG	30-2000MHZ	JB1	SUNOL	A091604-2	01106	I	20-OCT-2008
RED-BROWN BILOG	30-2000MHZ	JB1	SUNOL	A0032406	1218	I	04-AUG-2008
YELLOW HORN	1-18GHZ	3115	EMCO	9608-4898	00037	I	27-MAY-2007(EMI) / 18-MAY-2007 (RFI)
BLACK HORN	1-18GHZ	3115	EMCO	9703-5148	00056	I	17-JUN-2007
ORANGE HORN	1-18GHZ	3115	EMCO	0004-6123	00390	I	09-JUN-2007
HF (WHITE) HORN	18-26.5GHZ	801-WLM	WAVELINE	00758	00758	I	26-AUG-2007
SMALL LOOP	10KHZ-30MHZ	PLA-130/A	ARA	1024	00755	I	22-FEB-2008
LARGE LOOP	20HZ-5MHZ	6511	EMCO	9704-1154	00067	I	23-JAN-2008
ACTIVE MONOPOLE	30HZ-30MHZ	3301B	EMCO	3824	00068	II	06-DEC-2007
INDUCTION COIL	50-60HZ	1000-4-8	C-S	N/A	00778	II	26-SEP-2007
ADJUSTABLE DIPOLE	30-1000MHZ	3121C	EMCO	1370	00757	I	26-OCT-2008
ADJUSTABLE DIPOLE	30-1000MHZ	3121C	EMCO	1371	00756	I	09-NOV-2008
RE101 LOOP SENSOR	30HZ-100KHZ	RE101-13.3CM	C-S	N/A	00818	II	13-MAR-2007
RS101 RADIATING LOOP	30HZ-100KHZ	RS101-12CM	C-S	N/A	00819	II	13-MAR-2007
RS101 LOOP SENSOR	30HZ-100KHZ	RS101-4CM	C-S	N/A	00820	II	13-MAR-2007

EFT	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
EFT DIRECT COUPLING CAP	N/A	C-S	01	00794	II	06-FEB-2008

ESD GENERATORS	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
GREEN	NSG435	SCHAFFNER	000839	00763	I	25-OCT-2007
RED	NSG435	SCHAFFNER	001625	00762	I	06-JAN-2007
NSG-438 RENTAL	NSG438	SCHAFFNER	292	5265	I	04-APR-2007
YELLOW	930D	ETS	201	00673	I	18-AUG-2007

BEST EMC-2	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
BLUE	711-1100	SCHAFFNER	199824-002SC	00117	II	OUT FOR SERVICE
RED	711-1100	SCHAFFNER	200122-074SC	00623	II	31-MAR-2007 (SURGE / D+I) / 07-APR-2007 (EFT)

CHAMBERS AND STRIPLINE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
RFI 1 CHAMBER	3 METER COMPACT	PANASHIELD	N/A	00797	II	01-MAY-2007
RFI 2 CHAMBER	04' X 07' SHIELDING SYSTEM	LINDGREN	13329	00795	II	30-JUN-2007
RFI 3 STRIPLINE	N/A	C-S	N/A	00796	III	NA
ENVIRONMENTAL (SAFETY)	ECL5	B-M-A INC.	2041	00029	I	11-JAN-2007
ENVIRONMENTAL (SAFETY)	SGTH-31S	B-M-A INC.	2245	00321	I	11-JAN-2007

AMPLIFIERS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
RED	0.5-1000MHZ	10W1000B	AR	18708	00032	II	26-APR-2007 (RFI1)
GREEN	0.5-1000MHZ	10W1000B	AR	23423	00123	II	13-APR-2007 (RFI2)
BLUE	0.01-250MHZ	75A250	AR	19165	00039	II	03-NOV-2007 (NEBS & EU CRFI)
BLACK	0.01-250MHZ	75A250	AR	23411	00122	II	29-DEC-2007 (NEBS & EU CRFI)
ORANGE	0.01-250MHZ	75A250	AR	26827	00367	II	29-DEC-2007 (NEBS & EU CRFI) / 01-MAY-2007 (RFI1)
BROWN 150W	0.1-250MHZ	150A250	AR	313454	RENTAL	II	30-JUN-2007 (RFI2)
GTC 1-2.6	1.0-2.6 GHZ	GRF5016A	GTC	1221	RENTAL	II	18-MAY-2007
HUGHES 10W	2.0-4.0GHZ	1177H01	HUGHES	055	RENTAL	II	18-MAY-2007
HUGHES 10W	4.0-8.0GHZ	8010H02F	HUGHES	240	RENTAL	II	18-MAY-2007
HUGHES 10W	8-10.0GHZ	80108	HUGHES	138	RENTAL	II	18-MAY-2007
HP495A	7.0-10.0GHZ	HP495A	HP	304-00237	00086	II	OUT OF SERVICE (SPARE)
AUDIO AMP	AUDIO FREQ	MPA-200	RADIO SHACK	700438	NONE	III	NA
AUDIO AMP	AUDIO FREQ	MPA-200	RADIO SHACK	708545	00862	III	NA

FIELD PROBES	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
RED	0.01-1000MHZ	HI-4422	HOLADAY	90369	00031	I	01-MAR-2007
GREEN	0.01-1000MHZ	HI-4422	HOLADAY	97363	00136	I	25-JUL-2007
BLUE	0.01-1000MHZ	HI-4422	HOLADAY	95696	01100	I	25-MAR-2007
MICROWAVE SURVEY METER	2450MHZ	HI-1501	HOLADAY	00075464	1244	I	04-MAY-2007

SIGNAL GENERATORS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
RED	0.09-2000MHZ	HP8648B	Agilent	3847U02192	00366	I	28-FEB-2007
BLUE	0.1-1000MHZ	HP8648A	Agilent	3426A00548	00034	I	23-AUG-2007
GREEN	0.09-2000MHZ	HP8648B	Agilent	3623A02072	00125	I	16-OCT-2007
ORANGE	0.1-1000MHZ	HP8648B	Agilent	3537A01210	00025	I	29-JUN-2007
BROWN	0.01HZ-15MHZ	HP33120A	Agilent	US36016621	1211	I	OUT OF SERVICE
WHITE	0.01HZ-15MHZ	HP33120A	Agilent	US36048143	1219	I	10-MAY-2007
BROWN-WHITE	0.01HZ-15MHZ	HP33120A	Agilent	SG40019842	1232	I	10-NOV-2007
BLUE-WHITE	0.1HZ-13MHZ	HP3312A	Agilent	1432A07632	00775	I	11-MAR-2007
SWEEPER	0.01-20.0GHZ	HP83752A	Agilent	3610A01133	00087	II	02-MAY-2007
AM/FM STEREO SIG. GEN.	0.1-170MHZ	LG3236	LEADER	3687301	00959	I	10-OCT-2008
IMPULSE GENERATOR	1-100HZ	CIG-25	ELECTRO-METRICS	290	00942	I	05-AUG-2007

BULK INJECTION CLAMPS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
GREEN (NEBS CRFI)	0.01-100MHZ	95236-1	ETS	50215	00118	II	03-NOV-2007(BLUE AMP) 29-DEC-2007(ORANGE & BLK)
GREEN (EU CRFI)	0.10-100MHZ	95236-1	ETS	50215	00118	II	03-NOV-2007(BLUE AMP) 29-DEC-2007(ORANGE & BLK)
RED (NEBS CRFI)	0.01-100MHZ	95236-1	ETS	34026	1020	II	07-NOV-2007(BLUE AMP) 29-DEC-2007(ORANGE & BLK)
RED (EU CRFI)	0.10-100MHZ	95236-1	ETS	34026	1020	II	06-NOV-2007(BLUE AMP) 02-JAN-2008(ORANGE & BLK)
RENTAL	2 – 450MHZ	9142-1N	SOLAR	008508	RENTAL	II	10-AUG-2007

CDN NETWORKS	RANGE	MN	MFR	ASSET	CAT	CALIBRATION DUE
BLUE	0.10-100MHZ	20A M-3	C-S	00806	II	03-NOV-2007 (BLUE AMP) 29-DEC-2007 (ORANGE & BLK AMP)
RED	0.10-100MHZ	15A M-3	C-S	00780	II	03-NOV-2007 (BLUE AMP) 29-DEC-2007 (ORANGE & BLK AMP)
YELLOW-BLACK	0.10-100MHZ	15A M-3	C-S	00784	II	03-NOV-2007 (BLUE AMP) 29-DEC-2007 (ORANGE & BLK AMP)
GREEN	0.10-100MHZ	30A M-3	C-S	00779	II	03-NOV-2007 (BLUE AMP) 04-AUG-2007 (ORANGE & BLK AMP)
YELLOW	0.10-100MHZ	30A M-5	C-S	00804	II	03-NOV-2007(BLUE AMP) 05-APR-2007(ORANGE) 15-MAR-2007(BLK)
BROWN	0.10-100MHZ	M-3	C-S	1169	II	03-NOV-2007 (BLUE AMP) 29-DEC-2007 (ORANGE & BLK AMP)
BROWN-WHITE	0.10-100MHZ	M-3	C-S	1170	II	03-NOV-2007 (BLUE AMP) 29-DEC-2007 (ORANGE & BLK AMP)
BROWN-BLACK	0.10-100MHZ	M-2 (DC)	C-S	1171	II	03-NOV-2007 (BLUE AMP) 29-DEC-2007 (ORANGE & BLK AMP)
RED-BLACK	0.10-100MHZ	M-2 (DC)	C-S	1177	II	03-NOV-2007 (BLUE AMP) 29-DEC-2007 (ORANGE & BLK AMP)
GREEN-WHITE	0.10-100MHZ	M-2 (DC)	C-S		II	03-NOV-2007 (BLUE AMP) 29-DEC-2007 (ORANGE & BLK AMP)
YELLOW (RES)	0.10-100MHZ	100Ω RESISTOR	C-S	00810	II	04-NOV-2007(BLUE AMP) 06-NOV-2007(ORANGE) 02-JAN-2008(BLK)
GREEN (RES)	0.10-100MHZ	100Ω RESISTOR	C-S	1172	II	03-NOV-2007(BLUE AMP) 06-NOV-2007(ORANGE) 02-JAN-2008(BLK)

ANSI T1.315	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
SBC NOISE CART		C-S			III	CALIBRATION NOT REQUIRED
SBC TRANSIENT CART		C-S			III	WAVESHAPE VERIFIED BEFORE USE

OSCILLOSCOPES	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
EMC 100MHZ	TDS 220	TEKTRONIX	C036986	1166	I	28-AUG-2007
ESD REFERENCE 1GHZ	TDS 684B	TEKTRONIX	B011287	RENTAL	1	31-MAR-2007
PRODUCT SAFETY 100 MHZ	TDS 340	TEKTRONIX	B012357	00737	I	03-OCT-2007
TELECOM 100 MHZ	54645A	HP/AGILENT	US36320452	00103	I	30-JUN-2007

RMS VOLTMETERS/CURRENT CLAMP	MN	MNFR	SN	ASSET	CAT	CALIBRATION DUE
TRUE-RMS MULTIMETER	79III	FLUKE	71700298	00769	I	27-OCT-2007
TRUE RMS MULTIMETER	179	FLUKE	89280616	1228	I	31-OCT-2007
TRUE-RMS MULTIMETER (REFERENCE)	177	FLUKE	83390024	00973	I	21-MAR-2007
TRUE-RMS MULTIMETER	177	FLUKE	83390025	00974	I	10-MAR-2007
TRUE-RMS MULTIMETER (TELECOM)	177	FLUKE	83430419	00975	I	21-MAR-2007

SURGE GENERATORS	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
TRANSIENT WAVEFORM MONITOR	TWM-5	CDI	003982	00323	II	05-JUN-2007
UNIVERSAL SURGE GENERATOR	M5	CDI	003966	00324	II	OUT OF CAL
THREE PHASE COUPLING NWK	3CN	CDI	003455	00325	II	OUT OF CAL
1.2X50US PLUGIN MODULE	1.2X50US PLUGIN	CDI	N/A	00842	II	OUT OF CAL
10X160US PLUGIN MODULE	10X160US PLUGIN	C-S	N/A	00843	II	08-JUN-2007
10X560US PLUGIN MODULE	10X560US PLUGIN	C-S	N/A	00841	II	08-JUN-2007
PSURGE CONTROLLER MODULE	PSURGE 8000	HAEFELY	150267	00879	II	06-JUN-2007
COUPLING/DECOUPLING MODULE	PCD 900	HAEFELY	149213	00880	II	06-JUN-2007
IMPULSE MODULE	PIM 900	HAEFELY	149202	00881	II	06-JUN-2007
HIGH VOLTAGE CAP NWK 5KVDC, 18μF	CS-HVCC	C-S	01	00772	II	14-JUN-2008
NEBS SURGE GENERATOR	N/A	C-S	N/A	00088	II	18-OCT-2007
2X10US SURGE GENERATOR	2X10US	C-S	N/A	00846	II	06-JUN-2007
10X700US SURGE GENERATOR	10X700US	C-S	N/A	00847	II	08-JUN-2007
12 PAIR SURGE RESISTOR MODULE	N/A	C-S	N/A	00768	II	18-OCT-2007

POWER/NOISE METERS	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
POWER METER	435B	HP	2445A11012	00773	I	12-APR-2007
POWER METER	437B	HP	2912A01367	01099	I	12-APR-2007
POWER SENSOR	8481A	HP	2702A61351	00774	I	12-APR-2007
PSOPHOMETER	2429	BRUEL & KJAER	1237642	00585	II	14-FEB-2007
TRANSMISSION LINE TESTER (DBRNC)	185T	AMREL	998658	00823	II	16-MAR-2007

OVERVOLTAGE CHAMBERS	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
72KW POWER FAULT SIMULATOR	OV1	C-S	N/A	00792	II	31-MAR-2007
POWER FAULT SIMULATOR	OV2	C-S	N/A	00116	II	31-MAR-2007

DIPOLE TAPE MEASURES	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
26FT TAPE #1	2338CME	LUFKIN	C3166-1	00776	I	13-MAR-2007
26FT TAPE #2	2338CME	LUFKIN	C3166-2	00777	I	13-MAR-2007

METEOROLOGICAL METERS	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
TEMP./HUMIDITY/ATM. PRESSURE GAUGE	7400 PERCEPTION II	DAVIS	N/A	00965	II	08-FEB-2007
TEMPERATURE /HUMIDITY GAUGE	THG-912	HUGER	4000562	00789	I	01-FEB-2007
WEATHER CLOCK (PRESSURE ONLY)	BA928	OREGON SCIENTIFIC	C3166-1	00831	I	02-FEB-2007

CONSUMABLES	SPEC.	MFR	STOCK/MN	ASSET	CAT	CALIBRATION DUE
NEBS CHEESECLOTH	26-28M/KG	ED&D	ACC-01	N/A	III	N/A
NEBS CARBON BLOCK	3-MIL-GAP 1KV SURGE	RELIABLE	3AB	N/A	III	N/A

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

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 Confomidad
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.

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:

Location:	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.
Method of Marking:	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.
Scale:	The label shall be legible with characters generally larger than 3mm.
Color:	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.)
Identification of the supplier:	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 .

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 were 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.

Rev.160009121(2)_#684340 v13CS

A2LA Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999

CURTIS-STRAUS[1]
527 Great Road
Littleton, MA 01460
Barry Quinlan Phone: 978-486-8880
ELECTRICAL

Valid until: July 31, 2007 Certificate Number: 1627.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following Electromagnetic Compatibility (EMC), Telecommunications, and Product Safety tests:

Electromagnetic Compatibility (EMC)
Radiated emissions testing (electric and magnetic fields)*; Conducted emissions testing (voltage and current)*; Electrostatic Discharge testing*; Electrical Fast Transient testing*; Radiated Immunity testing*; Conducted Immunity testing*; Lightning Immunity testing*; Voltage Dips*, Interrupts and Voltage Variations testing*; Magnetic Immunity testing*; RF Power measurements*; Frequency Stability Measurements*; Longitudinal Induction measurements*; Harmonic emissions testing*; Light flicker testing*; Low frequency disturbance voltage testing*; Disturbance Power measurements*; Power Cross Overvoltage testing*;

Test Type	Test Method(s)
Emissions	
Radiated and Conducted Emissions	FCC 47 CFR Parts 15 & 18; C63.4; CISPR 22; EN55022; SABS CISPR 22; AS/NZS CISPR 22; AS/NZS 3548; Canada ICES-003; CNS13438; KN 22 (RRL No. 2005-82, September 29, 2005); CISPR 11; EN 55011; SABS CISPR 11; AS/NZS CISPR 11; AS/NZS 2064; Canada ICES-001; CNS13803; CISPR 13; EN 55013; SABS CISPR 13; AS/NZS CISPR 13; AS/NZS 1053; CISPR 14-1; EN 55014-1; SABS CISPR 14; AS/NZS CISPR 14; AS/NZS 1044; CNS 13439; CISPR 15; EN 55015; GR-1089-CORE; CSA C108.8-M1983;
Harmonics	EN 61000-3-2; AS/NZS 61000.3.2
Flicker	EN 61000-3-3; AS/NZS 61000.3.3

1 Note: This accreditation covers testing performed at the laboratory listed above and the satellite facility located at 168 Ayer Rd, Littleton, MA 01460 and, for test types marked with an asterisk, at other sites as defined in *"A2LA specific criteria for the accreditation of site testing and site calibration laboratories."*

Immunity	RRL No. 2005-130 (December 27, 2005)
Electrostatic Discharge (ESD)	EN 61000-4-2; AS/NZS 61000.4.2; KN61000-4-2
Radiated Immunity (RFI)	EN 61000-4-3, AS/NZS 61000.4.3; KN61000-4-3
Electrical Fast Transient Bursts (EFT)	EN 61000-4-4; AS/NZS 61000.4.4; KN61000-4-4
Surge	EN 61000-4-5, AS/NZS 61000.4.5; KN61000-4-5
Conducted Immunity	EN 61000-4-6, AS/NZS 61000.4.6; KN61000-4-6
Magnetic Immunity	EN 61000-4-8; AS/NZS 61000.4.8; KN61000-4-8
Voltage Dips and Interrupts	EN 61000-4-11; KN61000-4-11
Low Frequency Conducted Disturbances	EN 61000-2-2

Family Product or Industry Specific Specifications *including emissions and/or immunity*	GR-1089-CORE; GR-78-CORE (ESD) EN50081-1; EN50081-2; EN50082-2; EN50082-1; EN 61000-6-1; EN 61000-6-2; EN 61000-6-3; EN 61000-6-4; EN 50091-2; EN 55024; CISPR 24 EN 55103-1; EN 55103-2; EN 61326; EN 61547; EN 50130-4; EN 50083-2; EN 60601-1-2; EN 60601-2-2; EN 60601-2-24; EN 60601-2-32; EN 60601-2-38; EN 60601-2-47; IEC 1800-3; EN 61800-3; EN 55020; CISPR 20; EN 60555 Part 2; EN 60555 Part 3; ETS 300 386-1; EN 300 386-2; EN 300 386, ETS 300 132-1; ETS 300 132-2; EN 60669-2-1; AS/NZS 3200.1.2; CNS 13783-1; ETR 283; C62.41
Radiocommunications	
EU R&TTE Radio Standards;	EN 300 220-1; EN 300 220-3; EN 300 330-1; EN 300 330-2; EN 300 440-1; EN 300 440-2; EN 300 328; EN 300 385; EN 301 893
EU R&TTE EMC Standards	EN 300 339; EN 301 489-01; EN 301 489-03; EN 301 489-17
Canada Radio Standards	RSS-102; RSS-117; RSS-118; RSS-119; RSS-123; RSS-125; RSS-128; RSS-129; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134; RSS-135; RSS-136; RSS-137; RSS-138; RSS-141; RSS-142; RSS-170; RSS-181; RSS-182; RSS-187; RSS-188; RSS-191; RSS-192; RSS-193; RSS-195; RSS-210; RSS-212; RSS-213; RSS-215; RSS-243; RSS-GEN; RSS-310; GL-36;
Australia/New Zealand Radio Standards	AS/NZS 4268; AS/NZS 4771; RFS29; Radiocommunications (Data Transmission Equipment Using Spread Spectrum Modulation Techniques); Radiocommunications (Spread Spectrum Devices); Radiocommunications (Short Range Devices); Radiocommunications (Low Interference Potential Devices);

Other Radio Standards	RTTE 01 (DGT-Taiwan);

FCC Standards and Test methods Support TCB Status--	
FCC Scope A – Unlicensed Radio Frequency Devices	
A1	1. 47 CFR Parts 11, 15 and 18 2. FCC MP-5, 3. ANSI C63.4-2003,
A2	1. 47 CFR Part 15, 2. ANSI C63.4-2003,
A3	1. 47 CFR Part 15, 2. ANSI C63.17-1998, 3. ANSI C63.4-2003,
A4	1. 47 CFR Part 15, 2. ANSI C63.4-2003,
FCC Scope B – Licensed Radio Service Equipment	
B1	1. 47 CFR Parts 2, 22, 24, 25, and 27 2. ANSI/TIA-603-C (2004)
B2	1. 47 CFR Parts 2, 22, 74, 90, 95, and 97 2. ANSI/TIA-603-C (2004)
B3	1. 47 CFR Parts 2, 80, and 87 2. ANSI/TIA-603-C (2004)
B4	1. 47 CFR Parts 2, 21, 74, and 101 2. ANSI/TIA-603-C (2004)

Country Specific Standards and Other	
ITU EMC Standards	K.20; K.21; K.41; K.44
Swedish EMC Standards	BAKOM 3336.3
South African EMC Standards other then CISPR equivalents	SABS 1718-1; SANS 211/SABS CISPR 11; SANS 224/SABS CISPR 24; SANS 213/SABS CISPR 13; SANS 2200; SANS214-1/SABS CISPR 14-1; SANS214-2/SABS CISPR 14-2; SANS 215/SABS CISPR 15; SANS 222/SABS CISPR 22
Hong Kong EMC Standards	HKTA 1006; HKTA 1007; HKTA 1008; HKTA 1010; HKTA 1015; HKTA 1026; HKTA 1035; HKTA 1039; HKTA 1041; HKTA 1042; HKTA 1045
Singapore EMC Standards	IDA TS SRD; IDA TS EMC
Japanese VCCI Standards	VCCI V-3, VCCI V-4

Telecommunications
Telecommunications Registration; General test methods; Lightning surge*; Drop testing*; Balance testing*; Signal power (metallic and longitudinal)*; Frequency measurements*; Pulse templates*; Leakage testing*; Impedance testing*; Hearing Aid Compatibility testing (*excluding volume control*)*; Protocol analysis* and Jitter testing*.

Telecom Standards	Title
North American standards	
FCC 47 CFR Part 68 Telephone Terminal Equipment	Connection of terminal equipment to the telephone network. Analog and Digital Equipment. TCB Scope C1.
CS-03 Issue 9	Specification for terminal equipment, terminal systems, Network protection devices, connection arrangements and hearing aids compatibility.
TIA/EIA TSB31-B 1998	Bulletin Part 68 Rationale and Measurement Guidelines (Feb 1998)
TIA-968-A, A1, A2, A3	Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network
T1.TRQ.6-2001	Technical Requirements for SHDSL, HDSL2, HDSL4 Digital Subscriber Line Terminal Equipment to Prevent Harm to the Telephone Network Industry
Australia standards	
AS/ACIF S002-2001	Analogue interworking and non-interference requirements for Customer Equipment for connection to the Public Switched Telephone Network
AS/ACIF S016-2001	Requirements for Customer Equipment for connection to hierarchical digital interfaces
AS/ACIF S031-2001	Requirements for ISDN Basic Access Interface
AS/ACIF S038-2001	Requirements for ISDN Primary Rate Access Interface
AS/ACIF S043-2001	Requirements for Customer Equipment for Connection to a Metallic Local Loop Interface of a Telecommunications Network — Part 1: General Part 2: Broadband Part 3: DC, Low Frequency AC and Voice band
International standards	
ITU-T G.703	Physical/electrical characteristics of hierarchical Digital interfaces
Hong Kong standards	
HKTA 2011	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to Direct Exchange Lines (DEL) of the Public Switched Telephone Network (PSTN) in Hong Kong
HKTA 2014	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to the Public Telecommunications Network (PTN) in Hong Kong using ISDN Basic Rate Access (BRA) based on ITU-T Recommendations

Telecom Standards	Title
HKTA 2028	Network connection specification for connection of CPE to the PTNs in Hong Kong using digital leased circuits at data rate of 1544 kbit/s
HKTA 2029	Network connection specification for connection of CPE to the PTNs in Hong Kong using digital leased circuits at data rate of 2048 kbit/s
HKTA 2030	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to the Public Telecommunications Network (PTN) in Hong Kong using Digital Leased Circuits at nx64 kbit/s
HKTA 2031	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to the Public Telecommunications Network (PTN) in Hong Kong using Digital Leased Circuits below 64 kbit/s
HKTA 2032	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to the Public Telecommunications Networks in Hong Kong using Asymmetric Digital Subscriber Lines (ADSL) based on ITU-T Recommendation G.992.1
HKTA 2033	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to Fixed Telecommunications Networks in Hong Kong using Splitterless Asymmetric Digital Subscriber Lines (ADSL) based on ITU-T Recommendation G.992.2
European standards	
TBR 1: 1995	Attachment requirements for terminal equipment to Be connected to circuit switched data networks and Leased circuits using a CCITT Recommendation X.21 interface, or at an interface physically, functionally and electrically compatible with CCITT Recommendation X.21 but operating at any data signaling rate up to, and including, 1 984 kbit/s
TBR 2: 1997	Attachment requirements for Data Terminal Equipment (DTE) to connect to Packet Switched Public Data Networks (PSPDNs) for CCITT Recommendation X.25 interfaces at data signaling rates up to 1 920 kbit/s utilizing interfaces derived from CCITT Recommendations X.21 and X.21 bit
TBR 3: 1995 + Amdt : 1997	Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN basic access
TBR 4: 1995 + Amdt : 1997	Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN primary rate access
TBR 012: 1993 + Amdt : 1996	Business Telecommunications (BT); Open Network Provision (ONP) technical requirements; 2 048 kbit/s digital unstructured leased line (D2048U) Attachment requirements for terminal equipment
TBR 013: 1996	Business TeleCommunications (BTC); 2 048 kbit/s digital structured leased lines (D2048S); Attachment requirements for terminal equipment interface

European standards (cont'd)	
TBR 21: 1998	Terminal Equipment (TE); Attachment requirements For pan-European approval for connection to the Analogue Public Switched Telephone Networks (PSTNs) of TE (excluding TE supporting the voice telephony service) in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signaling
TBR 24: 1997	Business TeleCommunications (BTC); 34 Mbit/s Digital Unstructured and structured leased lines (D34U and D34S); Attachment requirements for Terminal equipment interface
Taiwan standards (DGT)	
ADSL01	Asymmetric Digital Subscriber Line Terminal Equipment and POTS Splitter Technical Specifications
ID0002	DS1 Equipment Type Approval Guidelines
IS6100	ISDN Terminal Equipment Technical Specifications
PSTN01 (non-voice only)	Technical Specifications for Terminal Equipment for Connection to Public Switched Telephone Network
New Zealand standards	
PTC 200 (non-voice only)	Requirements for Connection of Customer Equipment to Analogue Lines
PTC 217	Requirements for Bandwidth Management Devices
TNA 117	Telecom 2048 kbit/s Standard Network Interface
PTC 270	Interim arrangements for ADSL CPE
Singapore Standards	
IDA TS ADSL	Type Approval Specification for Asymmetric Digital Subscriber Line (Full-rate ADSL) Modems
IDA TS ADSL 2	Type Approval Specification for Asymmetric Digital Subscriber Line Splitterless (G-Lite) Modems
IDA TS DLCN 1	Type Approval Specification for Digital Interfaces based on hierarchical bit rates of 2048 kbit/s, 34 368 kbit/s and 139 264 kbit/s
IDA TS ISDN 1	Type Approval Specification for connection of Terminal Equipment to Integrated Services Digital Network (ISDN) Basic Access
IDA TS ISDN 2	Type Approval Specification for connection of Terminal Equipment to Integrated Services Digital Network (ISDN) Primary Rate Access (PRA)
IDA TS PSTN (non-voice only)	Type Approval Specification for connection of Terminal Equipment to Public Switched Telephone Network (PSTN)
South Africa standards	
TE-001 (non-voice only)	Standard for Telecommunication Line Terminal Equipment (TLTE) for Connection to the Public Switched Telephone Network (PSTN)

Product Safety
General test methods:
Power input*, Permanence of marking*, Accessibility*, Permissibly limits*, Energy hazard measurement*, SELV circuits*, TNV limits*, Limited current*, Capacitor Discharge / voltage limitation*, Ring signal*, Humidity conditioning*, Creepage / Clearance / Distance thru Insulation (excluding CTI)*, Limited power measurement*, Ground Bond/Earthing*, Ground continuity*, Temperature*, Stability*, Applied force*, Steel sphere impact*, Mold stress*, Battery reverse current*, Ball pressure*, Leakage current*, Component abnormal*, Electric strength*, Impulse*, Overvoltage*, Acoustic sound pressure*, 130mm / 20mm flame*, Needle flame*, Hot flaming oil*, Locked rotor/motor armature*, Vibration, Bump, Drop*, Strain relief*, Torque*, Insulation resistance*, Sound level*, Handle loading*, Liquid overflow*, Spillage*, Liquid leakage*, Transformer shorts/overloads*, Rain test*, Wall mount*, Laser radiation (excluding x-ray)*, Voltage surge*, Functionality*, Protective impedance abnormal*, Capacitor short circuit abnormal*, Output abnormal*, Multi-supply abnormal*, Cooling abnormal*, Heating device abnormal*, Interlock abnormal*, Rigidity*, Cleaning*

Product Safety Standards	Title
Specific Product Safety Standards	
UL 60950 2000	Safety of information technology equipment
IEC 60950 1999	Safety of information technology equipment
EN 60950 2000	Safety of information technology equipment, including
IEC 60950-1 2001	Electrical business equipment.
UL 60950-1 2003	
CSA C22.2 No. 60950-00	
CSA C22.2 No. 60950-1 03	
IEC 61010-1 1993	Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements.
EN 61010-1 1993, 2001	Safety requirements for electrical equipment for measurement,
IEC 61010-1 2001	control and laboratory use, Part 1: General requirements.
UL 61010B-1 2003	
CAN/CSA 1010-1 1999 (*Including AM 2*)	Electrical equipment for laboratory use Part 1: General requirements.
IEC 60601-1 1995	Medical electrical equipment. Part 1: General requirements for safety.
EN 60601-1 1995 (*Including AM 2*)	Medical electrical equipment
UL 2601-1 1997	Medical electrical equipment. Part 1: General Requirements for safety.
IEC 60065 1998, 2000	Audio, video and similar electronic apparatus – Safety requirements
ANSI/UL 6500: 1998	Audio/video and musical instrument apparatus for Household,
CAN/CSA 60065-00	commercial and similar general use Australian/New Zealand
AS/NZS 60065 2000	Standard – Approval and test Specification – Mains operated electronic and related Equipment for household and similar general use
Canadian C22.2 No. 1-94 (1-98)	Audio, video and similar electronic equipment.
1994, 1998	Consumer and commercial products
EN 60065 1994	Safety requirements for main operated electronic and related apparatus for household and similar general use.
IEC 60825 1990	Radiation safety of laser products, equipment Classification, requirements and user's guide
EN 60825-1 1994	Safety of laser products Part 1: equipment

Product Safety Standards	Title
IEC 60825-1 2001	Classification, requirements and user's guide.
IEC 60825-2 2000-5	Safety of laser products – Part 2: Safety of optical communication systems
IEC 60825-4 1997-11	Safety of laser products – Part 4: Laser guards
21 CFR 1040.10	Performance standard for laser products
IEC 60335-1 1995	Safety of household and similar electrical appliances
(*Including AM2 – 1997 & AM 12 – 1997*)	Part 1: General requirements
EN 60335-1 2001	
UL 60335-1 1998	
CAN/CSA E335-1 1994	
UL 61010A-1: 2002	Electrical equipment for laboratory use; part 1: General requirements
EN 61010-1: 2001	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
AS/NZS 60950: 2000	Safety information technology equipment
EN 60950-1: 2001	Information Technology Equipment – Safety – Part1: General Requirements
AS/NZS 60950.1: 2003	Information Technology Equipment – Safety – General requirements
UL 61010 -1: 2004	Electrical Equipment for Measurement, Control and Laboratory Use; Part 1: General Requirements
UL 60601-1: 2003	Medical Electrical Equipment, Part 1: General Requirements for Safety
IEC 60601-1-1: 2000	Medical Electrical Equipment - Part 1: General Requirements For Safety 1: Collateral Standard: Safety Requirements For Medical Electrical Systems
EN 60601-1-1: 2001	Medical Electrical Equipment - Part 1: General Requirements for Safety – Section 1-1. Collateral Standard: Safety Requirements For Medical Electrical Systems
UL 60065: 2003	Audio, Video and Similar Electronic Apparatus – Safety Requirements
CSA 60065: 2003	Audio, Video and Similar Electronic Apparatus – Safety Requirements
IEC 60065: 2001	Audio, Video and Similar Electronic Apparatus – Safety Requirements
EN 60065: 2002	Audio, Video and Similar Electronic Apparatus – Safety Requirements
EN 60204 -1: 1998	Safety of Machinery – Electrical Equipment of Machines – Part 1: Specification for General Requirements
HKTA 2001	Compliance Test Specification – Safety and Electrical Protection Requirements for Subscriber Equipment Connected to the Public Telecommunications Networks In Hong Kong

Environmental Simulation

Test Technology	Test Standard	Supporting Standards
Accessibility*	IEC 60529	IP-0x thru IP-6x
Acoustic Noise*	GR-63-CORE Sec 4.6	
Airborne Contaminants	GR-63-CORE Sec 4.5	MFG & Hygroscopic Dust
Altitude	GR-63-CORE Sec 4.1.3	
Cold Start*	ETS 300 019	IEC 60068-2-1
Drip	IEC 60529	IP-x1 & IP-x2
Drops*	ETS 300 019	IEC 60068-2-32
	GR-63-CORE Sec 4.3	
Dust	IEC 60529	IP-5x & IP-6x
Firearms Resistance Testing	GR-487	
Fire Resistance	ANSLT1.319	
	GR-63-CORE Sec 4.2	Fire & Needle Flame
Heat Dissipation*	GR-63-CORE Sec 4.1.4	
Illumination	GR-63-CORE Sec 4.7	
Operational Temperature & Humidity (OpTH)*	ETS 300 019	IEC 60068-2-1 IEC 60068-2-2 IEC 60068-2-14 IEC 60068-2-56
	GR-63-CORE Sec 4.1.2	
Salt Fog & Spray	ASTM B117	
Spatial*	GR-63-CORE Sec 2.0 & 3.0	
Spraying-Splashing	IEC 60529	IP-x3 & IP-x4
Storage (Temperature & Humidity)*	ETS 300 019	IEC 60068-2-1 IEC 60068-2-2 IEC 60068-2-14 IEC 60068-2-30 IEC 60068-2-56
	GR-63-CORE Sec 4.1.1	
Vibration	ETS 300 019	IEC 60068-2-6 IEC 60068-2-27 IEC 60068-2-29 IEC 60068-2-32 IEC 60068-2-57 IEC 60068-2-64 Earthquake, Office & Transportation
	GR-63-CORE Sec 4.4	
Water Immersion	IEC 60529	IP-x7 & IP-x8
Water Jet	IEC 60529	IP-x5 & IP-x6

Note 1. For standards or methods listed on the scope of accreditation without a revision date, laboratories are expected to be competent in the use of the current version within one year of the date of publication of the standard test method or upon the date specified by the standard test method originator when the originator has implementation authority. When a superseded standard or method is required for an accredited test, the scope will include the superseded date/version. For those that support the TCB/CB status of the organization acting as a certifier on behalf of the FCC or IC the expectation is currency within 30 days of Federal Register publication of changes for FCC and 30 days after IC website update. This note shall not be construed as an Accreditation Body implication to adopt a more current standard than is required in a regulation or code (i.e. the legal requirement) which is adopted by the lab under their responsibility.

* On-site test service is available for this technology, test, or method.