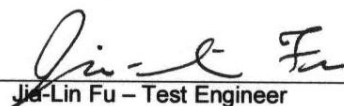
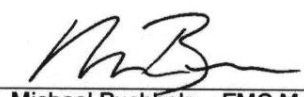


Report No	ED0704-2
Client	APC Corporation NPS Division Rick Everett
Address	85 Rangeway Road North Billerica, MA 01862
Phone	978-670-2440
Items tested	SYAF16KI and SYAF8KI
Standards	EN 55022:1998, FCC 47 CFR Part 15, VCCI, EN55024:1998, EN 50091-2:1996, EN61000-4-1:1997, EN61000-4-2:1999, EN61000-4-3:1998, EN61000-4-4:1995, EN61000-4-5:1995, EN61000-4-6:1996, EN61000-4-8:1994, EN61000-4-11:1994
Test Dates	September 12, 15 - 18, 2003
Results	As detailed within this report
Prepared by	 Jia-Lin Fu - Test Engineer
Authorized by	 Michael Buchholz - EMC Manager
Issue Date	<u>10/15/03</u>
Conditions of Issue	This Test Report is issued subject to the conditions stated in the 'Terms and Conditions' section on page 53 of this report.

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

## Contents

Contents .....	2
Summary .....	3
Product Tested - Configuration Documentation .....	4
VCCI Block Diagram .....	5
Performance Criteria .....	5
Performance Criteria .....	6
Compliance Statement .....	7
Modifications Required for Compliance .....	8
Test Results .....	9
Diagnostic Test Result .....	19
Test Descriptions .....	25
Radiated Emissions Testing Overview .....	25
Line Conducted Emissions Overview .....	28
EN55022:1998 Telco Cable Conducted Current Emissions Testing Overview .....	30
Radiated RF Immunity Testing Overview .....	32
Electrostatic Discharge Testing Overview .....	34
Electrical Fast Transient Burst Testing Overview .....	36
Conducted RF Immunity Testing Overview .....	38
Power Line Lightning Transient Testing .....	39
Test Equipment Used .....	41
Product Documentation .....	45
Jurisdictional Labeling and Required Instruction Manual Inserts .....	46
CE Marking - European Union (EU) .....	46
Sample Declaration of Conformity .....	46
EN 55022 Class A Warning Requirements .....	47
FCC Requirements .....	47
Australian Communications Authority Product Marketing .....	50
Canadian Requirements .....	51
VCCI Requirements .....	52
Terms and Conditions .....	53
A2LA Accreditation .....	55

Form Final Report REV 6-AUG-2003 (DW)

## Summary

On September 12, 15-18, 2003 we tested the Polar Bear SYAF16KI for compliance with the following requirements:

### EMC Emissions:

- EN 50091-2:96 Uninterruptible Power Systems (UPS) – emissions requirements
- EN 55022:1998 Class A ITE emissions requirements (EU)
- FCC 47 CFR Part 15 Class A emissions requirements (USA)
- VCCI Class A ITE emissions requirements (Japan)

Registration numbers for all open area test sites can be found in the "Test Equipment Used" Section starting on page 41.

### EMC Immunity:

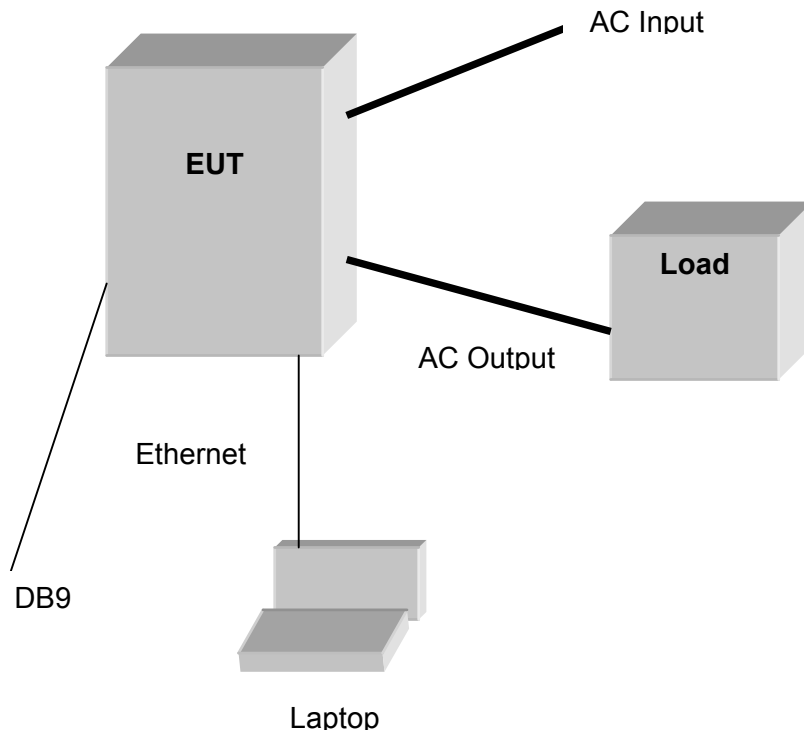
- EN 50091-2:96 Uninterruptible Power Systems (UPS) – immunity requirements *for the following – except for D.6 Immunity to low frequency signals:*
- EN 55024:1998/A1:2001 Information technology equipment - immunity characteristics *for the following:*
  - EN61000-4-1:1997 Overview of immunity
  - EN61000-4-2:1999 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, induced by radio-frequency fields
  - EN61000-4-8:1994 Magnetic immunity
  - EN61000-4-11:1994 Voltage dips, short interruptions and voltage variations immunity

We found that the product met the above requirements with modification (see *Modifications Required for Compliance* section on page 8). The SYAF8KI is also considered compliant since it is identical to the SYAF16KI, except it has two less power modules and batteries. The SYAF16KI would be the worse case version. The test sample was received in good condition.

**Product Tested - Configuration Documentation**

<b>EUT Configuration</b>				
<b>Work Order:</b> D0704				
<b>Company:</b> APC Corporation NPS Division				
<b>Company Address:</b> 85 Rangeway Road North Billerica, MA 01862				
<b>Contact:</b> Rick Everett				
<b>Person Present:</b> None				
<b>MN</b>		<b>SN</b>		<b>FCC ID</b>
EUT: SYAF16KI		FD0325001360		-
EUT Description: Polar Bear UPS				
EUT Max Frequency: 20 MHz				
<b>Support Equipment:</b>	<b>MN</b>	<b>SN</b>	<b>FCC ID</b>	
Load Box	K-490	292	-	
Load Box	K-490	395	-	
Dell Laptop	PP07L	CN-09U782-12961-364-3319	CXSM507BRD01D480	
<b>EUT Cables:</b>	<b>Qty</b>	<b>Shielded?</b>	<b>Length</b>	<b>Ferrites</b>
AC in	1	No	> 1 m	None
AC out	4	No	>1m	None
Ethernet	1	No	3m	None
Serial (dB-9)	1	Yes	> 1m	None
<b>Unpopulated EUT Ports:</b>	<b>Qty</b>	<b>Reason</b>		
Remote communication	1	Not used in the configuration		
AC out	3	Redundant		
Remote power view	1	Not used in the configuration		
DC to battery pack	1	Not used in the configuration		
dB-9 (front)	2	Diag, not used in the configuration		
<b>Software / Operating Mode Description:</b>				
UPS provide current to the load and the ethernet port continued to ping the laptop				

### VCCI Block Diagram



**Performance Criteria**

**Criterion A:** The unit must operate as intended during the test. In particular, the UPS shall continue to provide current to the load and the Ethernet port shall continue to ping the laptop.

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

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

**Compliance Statement**

TEST	RESULT	STANDARD	TEST LEVEL	MARGIN	COMMENTS
<b>Radiated Emissions</b>	PASS	EN55022 / FCC CFR 47 Part 15 / VCCI	Class A	-10.8 dB @ 212.4 MHz	CISPR Limit 80% online
<b>AC Mains Conducted Emissions</b>	PASS	EN55022 / FCC CFR 47 Part 15 / VCCI	Class A	-4.2 dB @ 0.15 MHz	FCC/CISPR Limit 50% discharging
<b>Telco Line Conducted Emissions</b>	PASS	EN55022	Class A	-9.3 dB @ 1.56 MHz	Ethernet (current)
<b>RFI - Amplitude Modulated</b>	PASS	EN61000-4-3 / IEC1000-4-3 / IEC 801-3 / ENV 50140	27 -1000 MHz 3 V/m 80% AM (1 kHz)	N/A	Performance Criteria A
<b>EFT</b>	PASS	EN61000-4-4 / IEC1000-4-4 / IEC 801-4	±1kV AC mains, ±0.5kV other	N/A	Performance Criteria B
<b>ESD</b>	PASS	EN 61000-4-2 / IEC1000-4-2 / IEC 801-2	±6kV contact, ±8kV air	N/A	Performance Criteria B
<b>CRFI</b>	PASS	EN61000-4-6 / IEC1000-4-6	3V, 0.15-80 MHz, 1kHz 80% AM	N/A	Performance Criteria A
<b>AC Surge</b>	PASS	EN61000-4-5 / IEC1000-4-5	±2kV Common ±1kV Differential	N/A	Performance Criteria B
<b>Power-Frequency Magnetic Field</b>	PASS	EN61000-4-8 / IEC1000-4-8	3 A/m	N/A	Performance Criteria A
<b>Voltage Dips</b>	N/A	EN61000-4-11 / IEC1000-4-11	<5%V for 10ms	N/A	>16A
			70%V for 500ms		>16A

TEST	RESULT	STANDARD	TEST LEVEL	MARGIN	COMMENTS
<b><i>Voltage Interruptions</i></b>	N/A	EN 61000-4-11 / IEC1000-4-11	<5%V for 5000ms	N/A	>16A

***Modifications Required for Compliance***

To pass AC conducted emissions at 50% on line, C12 and C14 were removed on the input filter board. To pass ESD, the DB-9 ports on the intelligence modules were grounded to the chassis/enclosure with copper tape.



**Test Results**

Radiated Emissions Table												Curtis-Straus LLC	
Date: 12-Sep-03			Company: APC Corporation NPS Division						Table 1				
Engineer: Mairaj HUSSain			EUT Desc: SYAF16KI						Work Order: D0704				
Frequency Range: 30 - 1000 MHz							Measurement Distance: 10 m						
Notes: Online 80% load							EUT Max Freq: 20 MHz						
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBμV/m)	CISPR Class A			FCC Class A			
							Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	
V	32.6	35.0	21.0	12.5	0.7	27.2	40.0	-12.8	Pass	39.1	-11.9	Pass	
V	38.2	29.2	21.0	10.2	0.8	19.2	40.0	-20.8	Pass	39.1	-19.9	Pass	
V	45.0	30.0	20.9	7.7	0.8	17.6	40.0	-22.4	Pass	39.1	-21.5	Pass	
V	52.8	30.3	20.9	5.7	0.9	16.0	40.0	-24.0	Pass	39.1	-23.1	Pass	
V	64.0	33.0	21.0	5.6	1.0	18.6	40.0	-21.4	Pass	39.1	-20.5	Pass	
V	100.0	39.6	20.9	6.0	1.3	26.0	40.0	-14.0	Pass	43.5	-17.5	Pass	
V	114.0	35.0	20.9	5.9	1.4	21.4	40.0	-18.6	Pass	43.5	-22.1	Pass	
V	160.7	28.5	21.0	8.6	1.7	17.8	40.0	-22.2	Pass	43.5	-25.7	Pass	
H	212.4	38.2	20.9	9.9	2.0	29.2	40.0	-10.8	Pass	43.5	-14.3	Pass	
H	244.0	30.0	20.9	10.9	2.2	22.2	47.0	-24.8	Pass	46.4	-24.2	Pass	
H	250.0	33.1	20.9	11.1	2.2	25.5	47.0	-21.5	Pass	46.4	-20.9	Pass	
Table Result: Pass by -10.8 dB Worst Freq: 212.4 MHz													
Test Site: "M"		Pre-Amp: Black		Cable: 65 ft RG8A/U		Analyzer: White		Antenna: Blue					

Radiated Emissions Table												Curtis-Straus LLC	
Date: 12-Sep-03				Company: APC Corporation NPS Division						Table 2			
Engineer: Mairaj HUSSain				EUT Desc: SYAF16KI						Work Order: D0704			
Frequency Range: 30 - 1000 MHz								Measurement Distance: 10 m					
Notes: 80% Off line								EUT Max Freq: 20 MHz					
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBμV/m)	CISPR Class A			FCC Class A			
							Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	
V	32.0	30.0	21.0	12.8	0.7	22.5	40.0	-17.5	Pass	39.1	-16.6	Pass	
V	44.0	33.9	20.9	8.1	0.8	21.9	40.0	-18.1	Pass	39.1	-17.2	Pass	
V	56.8	35.7	20.9	5.4	0.9	21.1	40.0	-18.9	Pass	39.1	-18.0	Pass	
V	64.0	31.5	21.0	5.6	1.0	17.1	40.0	-22.9	Pass	39.1	-22.0	Pass	
V	80.0	36.8	21.0	7.0	1.1	23.9	40.0	-16.1	Pass	39.1	-15.2	Pass	
V	100.0	39.0	20.9	6.0	1.3	25.4	40.0	-14.6	Pass	43.5	-18.1	Pass	
Table Result: Pass by -14.6 dB Worst Freq: 100.0 MHz													
Test Site: "M"		Pre-Amp: Black		Cable: 65 ft RG8A/U		Analyzer: White		Antenna: Blue					

Radiated Emissions Table												Curtis-Straus LLC	
Date: 12-Sep-03				Company: APC Corporation NPS Division						Table 3			
Engineer: Mairaj HUSSain				EUT Desc: SYAF16KI						Work Order: D0704			
Frequency Range: 30 - 1000 MHz								Measurement Distance: 10 m					
Notes: On line 50%								EUT Max Freq: 20 MHz					
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBμV/m)	CISPR Class A			FCC Class A			
							Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	
V	31.9	28.0	21.0	12.9	0.7	20.6	40.0	-19.4	Pass	39.1	-18.5	Pass	
V	42.6	29.0	20.9	8.6	0.8	17.5	40.0	-22.5	Pass	39.1	-21.6	Pass	
V	45.3	30.0	20.9	7.6	0.8	17.5	40.0	-22.5	Pass	39.1	-21.6	Pass	
V	64.0	31.6	21.0	5.6	1.0	17.2	40.0	-22.8	Pass	39.1	-21.9	Pass	
V	80.0	35.6	21.0	7.0	1.1	22.7	40.0	-17.3	Pass	39.1	-16.4	Pass	
V	100.0	39.7	20.9	6.0	1.3	26.1	40.0	-13.9	Pass	43.5	-17.4	Pass	
H	200.0	30.5	20.9	9.5	1.9	21.0	40.0	-19.0	Pass	43.5	-22.5	Pass	
H	250.0	33.3	20.9	11.1	2.2	25.7	47.0	-21.3	Pass	46.4	-20.7	Pass	
Table Result: Pass by -13.9 dB Worst Freq: 100.0 MHz													
Test Site: "M"		Pre-Amp: Black		Cable: 65 ft RG8A/U		Analyzer: White		Antenna: Blue					

Radiated Emissions Table										Curtis-Straus LLC			
Date: 12-Sep-03			Company: APC Corporation NPS Division						Table 4				
Engineer: Mairaj HUSSain			EUT Desc: SYAF16KI						Work Order: D0704				
Frequency Range: 30 - 1000 MHz							Measurement Distance: 10 m						
Notes: Off Line 50%							EUT Max Freq: 20 MHz						
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBμV/m)	CISPR Class A			FCC Class A			
							Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	
V	32.7	33.8	21.0	12.5	0.7	26.0	40.0	-14.0	Pass	39.1	-13.1	Pass	
V	40.0	34.5	21.0	9.6	0.8	23.9	40.0	-16.1	Pass	39.1	-15.2	Pass	
V	44.6	31.5	20.9	7.9	0.8	19.3	40.0	-20.7	Pass	39.1	-19.8	Pass	
V	45.7	34.4	34.4	7.5	0.8	21.8	40.0	-18.2	Pass	39.1	-17.3	Pass	
V	64.9	33.0	21.0	5.8	1.0	18.8	40.0	-21.2	Pass	39.1	-20.3	Pass	
V	80.0	34.0	21.0	7.0	1.1	21.1	40.0	-18.9	Pass	39.1	-18.0	Pass	
V	100.0	40.4	20.9	6.0	1.3	26.8	40.0	-13.2	Pass	43.5	-16.7	Pass	
Table Result: Pass by -13.1 dB										Worst Freq: 32.7 MHz			
Test Site: "M"		Pre-Amp: Black		Cable: 65 ft RG8A/U		Analyzer: White		Antenna: Blue					

AC Mains Conducted Emissions										Curtis-Straus LLC			
Date: 12-Sep-03			Company: APC Corporation NPS Division						Table No: 5				
Engineer: Mairaj Hussain			EUT Desc: SYAF16KI						Work Order: D0704				
Notes: On Line 83% Load										Test Site: EMI2			
LISN(s): White-Black Black Red-Black Blue-Black													
Range: 0.15-30Mhz					Other Equipment: ---				Spectrum Analyzer: Black				
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	FCC A Applicable until July 12, 2004		FCC/CISPR A		FCC/CISPR A		Overall Result (Pass/Fail)	
	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
L1					---								
0.15	45.2		26.0		20.0			79.0	-13.8	66.0	-20.0	Pass	
0.17	38.4		21.0		20.0			79.0	-20.6	66.0	-25.0	Pass	
1.63	24.6				20.0	60.0	-15.4	73.0	-28.4	60.0	-15.4	Pass	
1.68	23.7				20.0	60.0	-16.3	73.0	-29.3	60.0	-16.3	Pass	
3.43	23.3				20.0	69.5	-26.2	73.0	-29.7	60.0	-16.7	Pass	
3.66	25.5				20.0	69.5	-24.0	73.0	-27.5	60.0	-14.5	Pass	
4.63	28.1				20.0	69.5	-21.4	73.0	-24.9	60.0	-11.9	Pass	
12.00	21.4				20.0	69.5	-28.1	73.0	-31.6	60.0	-18.6	Pass	
29.60	20.5				20.0	69.5	-29.0	73.0	-32.5	60.0	-19.5	Pass	
L2													
0.15	54.3		37.0		20.0			79.0	-4.7	66.0	-9.0	Pass	
0.16	48.9		30.0		20.0			79.0	-10.1	66.0	-16.0	Pass	
0.17	51.5		36.0		20.0			79.0	-7.5	66.0	-10.0	Pass	
1.63	26.1				20.0	60.0	-13.9	73.0	-26.9	60.0	-13.9	Pass	
1.69	25.0				20.0	60.0	-15.0	73.0	-28.0	60.0	-15.0	Pass	
3.51	24.0				20.0	69.5	-25.5	73.0	-29.0	60.0	-16.0	Pass	
4.64	27.0				20.0	69.5	-22.5	73.0	-26.0	60.0	-13.0	Pass	
8.19	32.1		25.0		20.0	69.5	-30.4	73.0	-20.9	60.0	-15.0	Pass	
8.24	31.4		21.0		20.0	69.5	-31.1	73.0	-21.6	60.0	-19.0	Pass	
Table Result: Pass by -4.70 dB Worst Freq: 0.15 MHz													

AC Mains Conducted Emissions											Curtis-Straus LLC		
Date: 12-Sep-03				Company: APC Corporation NPS Division						Table No: 6			
Engineer: Mairaj Hussain				EUT Desc: SYAF16KI						Work Order: D0704			
Notes: On Line 83% Load											Test Site: EMI2		
LISN(s): White-Black Black Red-Black Blue-Black													
Range: 0.15-30Mhz				Other Equipment: ---				Spectrum Analyzer: Black					
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	FCC A Applicable until July 12, 2004		FCC/CISPR A		FCC/CISPR A		Overall Result  (Pass/Fail)	
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB		
L3													
0.15	53.3		36.8		20.0			79.0	-5.7	66.0	-9.2	Pass	
0.17	51.0		36.2		20.0			79.0	-8.0	66.0	-9.8	Pass	
1.64	25.6				20.0	60.0	-14.4	73.0	-27.4	60.0	-14.4	Pass	
1.70	25.7				20.0	60.0	-14.3	73.0	-27.3	60.0	-14.3	Pass	
4.62	22.7				20.0	69.5	-26.8	73.0	-30.3	60.0	-17.3	Pass	
8.00	28.4				20.0	69.5	-21.1	73.0	-24.6	60.0	-11.6	Pass	
8.11	28.2				20.0	69.5	-21.3	73.0	-24.8	60.0	-11.8	Pass	
9.36	22.0				20.0	69.5	-27.5	73.0	-31.0	60.0	-18.0	Pass	
29.72	19.0				20.0	69.5	-30.5	73.0	-34.0	60.0	-21.0	Pass	
Table Result: Pass by -5.70 dB Worst Freq: 0.15 MHz													

AC Mains Conducted Emissions											Curtis-Straus LLC	
Date: 15-Sep-03			Company: APC Corporation NPS Division						Table No: 7			
Engineer: Matt Deeter			EUT Desc: SYAF16KI						Work Order: D0704			
Notes: 83% Load Discharging											Test Site: EMI2	
LISN(s): White-Black Black Red-Black Blue-Black												
Range: 0.15-30Mhz			Other Equipment: ---				Spectrum Analyzer: Blue					
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	FCC A Applicable until July 12, 2004		FCC/CISPR A		FCC/CISPR A		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
Line 1					---	---	---	---	---	---	---	---
0.15	13.6				20.0	---	---	79.0	-45.5	66.0	-32.5	Pass
0.17	9.2				20.0	---	---	79.0	-49.8	66.0	-36.8	Pass
1.68	18.5				20.0	60.0	-21.5	73.0	-34.5	60.0	-21.5	Pass
3.43	8.3				20.0	69.5	-41.2	73.0	-44.7	60.0	-31.7	Pass
3.66	6.6				20.0	69.5	-42.9	73.0	-46.4	60.0	-33.4	Pass
4.63	6.1				20.0	69.5	-43.4	73.0	-46.9	60.0	-33.9	Pass
12.00	2.5				20.0	69.5	-47.0	73.0	-50.5	60.0	-37.5	Pass
29.60	2.3				20.0	69.5	-47.2	73.0	-50.7	60.0	-37.7	Pass
Line 2					---	---	---	---	---	---	---	---
0.15	13.0				20.0	---	---	79.0	-46.0	66.0	-33.0	Pass
0.17	9.3				20.0	---	---	79.0	-49.7	66.0	-36.7	Pass
1.63	18.6				20.0	60.0	-21.4	73.0	-34.4	60.0	-21.4	Pass
3.51	8.1				20.0	69.5	-41.4	73.0	-44.9	60.0	-31.9	Pass
4.64	6.1				20.0	69.5	-43.4	73.0	-46.9	60.0	-33.9	Pass
8.19	6.1				20.0	69.5	-43.4	73.0	-46.9	60.0	-33.9	Pass
8.24	6.1				20.0	69.5	-43.4	73.0	-46.9	60.0	-33.9	Pass
Line 3					---	---	---	---	---	---	---	---
0.15	9.7				20.0	---	---	79.0	-49.3	66.0	-36.3	Pass
0.17	8.4				20.0	---	---	79.0	-50.6	66.0	-37.6	Pass
1.68	18.1				20.0	60.0	-21.9	73.0	-34.9	60.0	-21.9	Pass
3.43	6.9				20.0	69.5	-42.6	73.0	-46.1	60.0	-33.1	Pass
3.66	5.5				20.0	69.5	-44.0	73.0	-47.5	60.0	-34.5	Pass
4.63	6.9				20.0	69.5	-42.6	73.0	-46.1	60.0	-33.1	Pass
12.00	2.6				20.0	69.5	-46.9	73.0	-50.4	60.0	-37.4	Pass
29.60	4.5				20.0	69.5	-45.0	73.0	-48.5	60.0	-35.5	Pass
Table Result: Pass by -21.43 dB Worst Freq: 1.63 MHz												

AC Mains Conducted Emissions											Curtis-Straus LLC	
Date: 15-Sep-03			Company: APC Corporation NPS Division						Table No: 8			
Engineer: Matt Deeter			EUT Desc: SYAF16KI						Work Order: D0704			
Notes: 50% Load Charging *Removed C12, C14											Test Site: EMI2	
LISN(s): White-Black Black Red-Black Blue-Black												
Range: 0.15-30Mhz			Other Equipment: ---				Spectrum Analyzer: Blue					
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	FCC A Applicable until July 12, 2004		FCC/CISPR A		FCC/CISPR A		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
Line 1					---	---	---	---	---	---	---	---
*0.15	49.4		29.5		20.0	---	---	79.0	-9.6	66.0	-16.5	Pass
*0.17	40.4		26.7		20.0	---	---	79.0	-18.6	66.0	-19.3	Pass
0.92	10.0				20.0	60.0	-30.0	73.0	-43.0	60.0	-30.0	Pass
1.62	20.7		14.0		20.0	60.0	-32.3	73.0	-32.3	60.0	-26.0	Pass
3.73	17.4		16.6		20.0	69.5	-32.1	73.0	-35.6	60.0	-23.4	Pass
4.46	27.4		21.7		20.0	69.5	-22.1	73.0	-25.6	60.0	-18.3	Pass
9.52	21.2		17.2		20.0	69.5	-28.3	73.0	-31.8	60.0	-22.8	Pass
26.76	16.9		13.9		20.0	69.5	-32.6	73.0	-36.1	60.0	-26.1	Pass
29.73	21.0		19.3		20.0	69.5	-28.5	73.0	-32.0	60.0	-20.7	Pass
Line 2					---	---	---	---	---	---	---	---
*0.15	54.6		33.0		20.0	---	---	79.0	-4.4	66.0	-13.0	Pass
*0.17	48.0		33.0		20.0	---	---	79.0	-11.0	66.0	-13.0	Pass
1.64	21.4		16.3		20.0	60.0	-18.6	73.0	-31.6	60.0	-23.7	Pass
3.50	26.0		18.1		20.0	69.5	-36.5	73.0	-27.0	60.0	-21.9	Pass
4.66	25.0		18.5		20.0	69.5	-37.5	73.0	-28.0	60.0	-21.5	Pass
8.12	31.4		21.4		20.0	69.5	-31.1	73.0	-21.6	60.0	-18.6	Pass
29.69	12.6				20.0	69.5	-36.9	73.0	-40.4	60.0	-27.4	Pass
29.74	9.8				20.0	69.5	-39.8	73.0	-43.3	60.0	-30.3	Pass
Line 3					---	---	---	---	---	---	---	---
*0.15	50.4		31.2		20.0	---	---	79.0	-8.6	66.0	-14.8	Pass
*0.17	45.2		32.3		20.0	---	---	79.0	-13.8	66.0	-13.7	Pass
1.65	21.9		16.2		20.0	60.0	-18.1	73.0	-31.1	60.0	-23.8	Pass
4.62	20.2		13.5		20.0	69.5	-42.3	73.0	-32.8	60.0	-26.5	Pass
7.72	24.3		13.5		20.0	69.5	-38.2	73.0	-28.7	60.0	-26.5	Pass
8.15	27.4		18.6		20.0	69.5	-35.1	73.0	-25.6	60.0	-21.4	Pass
26.76	10.9		8.4		20.0	69.5	-38.7	73.0	-42.2	60.0	-31.6	Pass
29.74	19.0		18.2		20.0	69.5	-30.5	73.0	-34.0	60.0	-21.8	Pass
Table Result: Pass by -4.40 dB											Worst Freq: 0.15 MHz	

AC Mains Conducted Emissions										Curtis-Straus LLC		
Date: 15-Sep-03			Company: APC Corporation NPS Division						Table No: 9			
Engineer: Matt Deeter			EUT Desc: SYAF16K1						Work Order: D0704			
Notes: 50% Load Discharging										Test Site: EMI2		
LISN(s): White-Black Black Red-Black Blue-Black												
Range: 0.15-30Mhz			Other Equipment: ---				Spectrum Analyzer: Blue					
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	FCC A Applicable until July 12, 2004		FCC/CISPR A		FCC/CISPR A		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
Line 1					---	---	---	---	---	---	---	---
0.15	27.3		6.2		20.0	---	---	79.0	-31.7	66.0	-39.8	Pass
0.17	20.4				20.0	---	---	79.0	-38.6	66.0	-25.6	Pass
0.45	35.6		5.0		20.0	60.0	-17.4	79.0	-23.4	66.0	-41.0	Pass
1.62	10.8				20.0	60.0	-29.2	73.0	-42.2	60.0	-29.2	Pass
3.73	4.7				20.0	69.5	-44.8	73.0	-48.3	60.0	-35.3	Pass
4.46	10.4				20.0	69.5	-39.1	73.0	-42.6	60.0	-29.6	Pass
9.52	13.4				20.0	69.5	-36.1	73.0	-39.6	60.0	-26.6	Pass
26.76	8.6				20.0	69.5	-40.9	73.0	-44.4	60.0	-31.4	Pass
29.73	2.0				20.0	69.5	-47.5	73.0	-51.0	60.0	-38.0	Pass
Line 2					---	---	---	---	---	---	---	---
0.15	54.9		4.0		20.0	---	---	79.0	-4.2	66.0	-42.0	Pass
0.17	46.1		6.2		20.0	---	---	79.0	-12.9	66.0	-39.8	Pass
1.64	13.1				20.0	60.0	-26.9	73.0	-39.9	60.0	-26.9	Pass
3.50	5.5				20.0	69.5	-44.0	73.0	-47.5	60.0	-34.5	Pass
4.66	7.0				20.0	69.5	-42.5	73.0	-46.0	60.0	-33.0	Pass
8.12	4.6				20.0	69.5	-44.9	73.0	-48.4	60.0	-35.4	Pass
29.69	2.2				20.0	69.5	-47.3	73.0	-50.8	60.0	-37.8	Pass
29.74	9.5				20.0	69.5	-40.1	73.0	-43.6	60.0	-30.6	Pass
Line 3					---	---	---	---	---	---	---	---
0.15	53.1		5.3		20.0	---	---	79.0	-5.9	66.0	-40.7	Pass
0.17	45.1		4.2		20.0	---	---	79.0	-13.9	66.0	-41.8	Pass
1.65	16.0				20.0	60.0	-24.0	73.0	-37.0	60.0	-24.0	Pass
4.62	8.3				20.0	69.5	-41.2	73.0	-44.7	60.0	-31.7	Pass
9.37	9.5				20.0	69.5	-40.0	73.0	-43.5	60.0	-30.5	Pass
9.52	13.1				20.0	69.5	-36.4	73.0	-39.9	60.0	-26.9	Pass
26.76	6.5				20.0	69.5	-43.0	73.0	-46.5	60.0	-33.5	Pass
29.74	3.1				20.0	69.5	-46.4	73.0	-49.9	60.0	-36.9	Pass
Table Result: Pass by -4.20 dB Worst Freq: 0.15 MHz												

Telco Conducted Emissions - Current											Curtis-Straus LLC	
Date: 16-Sep-03			Company: APC Corporation NPS Division						Table No: 10			
Engineer: Matt Deeter			EUT Desc: SYA16K161						Work Order: D0704			
Notes: Rear Ethernet											Test Site: EMI3	
LISN(s): ---												
Range: 0.15-30Mhz			Other Equipment: Blue Current Clamp				Spectrum Analyzer: Blue					
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	---		022:98 telco current (A)		022:98 telco current (A)		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		Limit (dBµV)	Margin dB	qp Limit (dBµA)	qp Margin dB	AVE Limit (dBµA)	AVE Margin dB	
0.32	18.2		6.8		0.3	---	---	46.8	-28.3	33.8	-26.7	Pass
0.41	22.4		9.6		0.3	---	---	44.7	-22.0	31.7	-21.8	Pass
0.49	23.7		9.5		0.3	---	---	43.2	-19.3	30.2	-20.5	Pass
0.96	17.2		12.4		0.1	---	---	43.0	-25.7	30.0	-17.5	Pass
1.56	27.6		20.7		0.0	---	---	43.0	-15.4	30.0	-9.3	Pass
5.88	3.4				0.0	---	---	43.0	-39.6	30.0	-26.6	Pass
Table Result: Pass by -9.30 dB Worst Freq: 1.56 MHz												

Telco Conducted Emissions - Voltage											Curtis-Straus LLC	
Date: 16-Sep-03			Company: APC Corporation NPS Division						Table No: 11			
Engineer: Matt Deeter			EUT Desc: SYA16K161						Work Order: D0704			
Notes: Rear Ethernet											Test Site: EMI3	
LISN(s): ---												
Range: 0.15-30Mhz			Other Equipment: Telco Voltage Probe					Spectrum Analyzer: Blue				
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	---		022:98 telco voltage (A)		022:98 telco voltage (A)		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
0.32	24.4		13.7		30.0	---	---	90.8	-36.4	77.8	-34.1	Pass
0.41	26.2		20.8		30.0	---	---	88.7	-32.6	75.7	-24.9	Pass
0.48	40.2		25.9		30.0	---	---	87.4	-17.1	74.4	-18.5	Pass
0.49	41.0		25.4		30.0	---	---	87.2	-16.2	74.2	-18.8	Pass
0.56	28.1		21.7		30.0	---	---	87.0	-28.9	74.0	-22.3	Pass
1.12	36.5		31.4		30.0	---	---	87.0	-20.5	74.0	-12.6	Pass
Table Result: Pass by -12.60 dB Worst Freq: 1.12 MHz												

RFI DATA SHEET				
<b>Work Order:</b> D0704		<b>Table:</b> 12		
<b>Date:</b> 16-Sep-03				
<b>Engineer:</b> Matt Deeter				
<b>EUT:</b> SYAF16KI				
<b>Company:</b> APC Corporation NPS Division				
<b>Modifications since start date:</b> See Modifications				
<b>Modifications this test:</b> none				
<b>Testing Location:</b>	527 Great Road - Main Building, Littleton, MA 01460			
<b>Performance Criteria:</b>	A			
<b>Frequency Range:</b>	27-1000MHz			
<b>Maximum Test Parameters:</b>	3 V/m			
<b>Modulation:</b>	80% AM @ 1kHz			
<b>Dwell Frequencies:</b>	80, 120, 160, 230, 434, 460, 600, 863, 900MHz			
<b>Test Equipment Used:</b>				
	<b>Amplifier:</b> Red, Black		<b>Signal Generator:</b> Red	
	<b>Antenna:</b> Yel/Blk		<b>Field Probe:</b> Red	
<b>Atmospheric Conditions:</b>				
	<b>Temp:</b> 23°C	<b>Humidity:</b> 44%	<b>Pressure:</b> 1008mbar	
<b>Results:</b>				
	<b>Front</b>	<b>Right</b>	<b>Back</b>	<b>Left</b>
<b>Horizontal</b>	Pass	Pass	Pass	Pass
<b>Vertical</b>	Pass	Pass	Pass	Pass

EFT DATA SHEET		
<b>Work Order:</b> D0704		<b>Table:</b> 13
<b>Date:</b> 17-Sep-03		
<b>Engineer:</b> Arik Zwirner		
<b>EUT:</b> SYAF16KI		
<b>Company:</b> APC		
<b>Modifications since start date:</b> See Modifications		
<b>Modifications this test:</b> none		
<b>Testing Location:</b>	527 Great Road - Main Building, Littleton, MA 01460	
<b>Performance Criteria:</b>	B	
<b>Test Equipment:</b>	Blue BEST EMC Test Instrument Package	
<b>Maximum Test Parameters:</b>	±1 kV-AC	±0.5 kV-Cables
<b>Atmospheric Conditions:</b>		
<b>Temp:</b> 20°C	<b>Humidity:</b> 48%	<b>Pressure:</b> 1018mbar
<b>Test Points:</b>	<b>Pass/Fail</b>	<b>Comments:</b>
AC mains	PASS	
<b>Cables:</b>		
AC Output	PASS	
DB9 cable	PASS	
Ethernet	PASS	

ESD DATA SHEET		
<b>Work Order:</b> D0704		<b>Table:</b> 14
<b>Date:</b> 17-Sep-03		
<b>Engineer:</b> Arik Zwirner		
<b>EUT:</b> SYAF16KI		
<b>Company:</b> APC		
<b>Modifications since start date:</b> See Modifications		
<b>Modifications this test:</b> The DB-9 ports on the intelligence modules were grounded to the chassis/enclosure, using copper tape.		
<b>Testing Location:</b> 527 Great Road - Main Building, Littleton, MA 01460		
<b>Performance Criteria:</b> B		
<b>Test Equipment:</b> Schaffner NSG 435		<b>Gun:</b> Green
<b>Maximum Test Parameters:</b> ± 8 kV-air ± 6 kV-contact		
<b>Atmospheric Conditions:</b> <b>Temp:</b> 20°C <b>Humidity:</b> 48% <b>Pressure:</b> 1018mbar		
<b>Test Points:</b>	<b>Pass/Fail</b>	<b>Comments:</b>
Horizontal Coupling Plane	Pass	±2kV, ±4kV, ±6kV
Vertical Coupling Plane	Pass	±2kV, ±4kV, ±6kV
<b>Contact Discharge Test Points</b>	Pass	±2kV, ±4kV, ±6kV
Intelligence Modules: module enclosure screws, chassis around module, chassis screws, faceplate, adjacent to RJ45 port, shell of DB9 port		
Battery Modules: faceplate, vents, chassis adjacent to module		
Power Modules: fan vents, faceplate, module enclosure screws, chassis adjacent to module		
Top and Side Panels: center of panel, corners		
Back: adjacent to AC-output breakers, Ethernet port, chassis screws DB9 port, adjacent to AC-mains and AC-output ports, On/Off breaker		
Control Module: metal bracket, screws		
<b>Air Discharge Test Points</b>	Pass	±2kV, ±4kV, ±8kV
Control Modules: case seams, LED's, LCD		
Front and Back: breakers		
Battery Modules: battery disconnect switch		

CRFI DATA SHEET		
<b>Work Order:</b> D0704		<b>Table:</b> 15
<b>Date:</b> 17-Sep-03		
<b>Engineer:</b> Arik Zwirner		
<b>EUT:</b> SYAF16KI		
<b>Company:</b> APC		
<b>Modifications since start date:</b> See Modifications		
<b>Modifications this test:</b> none		
<b>Testing Location:</b>	527 Great Road - Main Building, Littleton, MA 01460	
<b>Performance Criteria:</b>	A	
<b>Test Equipment:</b>		
<b>Sig Gen:</b> Blue	<b>Amp:</b> Blue	
	<b>Resistor Network:</b> Green	<b>Injection Clamp:</b> Red
<b>Maximum Test Parameters:</b>		
<b>Signal Level:</b>	3 Vrms	
<b>Modulation:</b>	80% AM @ 1kHz sine	
<b>Frequency Range:</b>	0.15-80MHz	
<b>Dwell Frequencies:</b>	0.2, 1.0, 7.1, 13.56, 21, 27.12, 40.68MHz	
<b>Atmospheric Conditions:</b>		
<b>Temp:</b> 20°C	<b>Humidity:</b> 48%	<b>Pressure:</b> 1018mbar
<b>Test Points:</b>	<b>Pass/Fail</b>	<b>Comments:</b>
AC Mains	PASS	
AC Output	PASS	
DB9 cable	PASS	
Ethernet	PASS	



SURGE DATA SHEET		
<b>Work Order:</b> D0704		<b>Table:</b> 16
<b>Date:</b> 18-Sep-03		
<b>Engineer:</b> Jia-Lin Fu		
<b>EUT:</b> SYAF16KI		
<b>Company:</b> APC		
<b>Modifications since start date:</b> See Modifications		
<b>Modifications this test:</b> none		
<b>Testing Location:</b>	527 Great Road - Main Building, Littleton, MA 01460	
<b>Performance Criteria:</b>	B	
<b>Test Equipment:</b> CDI M5		
<b>Maximum Test Parameters:</b> <i>Input and Output AC Power Ports</i>		
Open Circuit Waveshape:	1.2/50	Tr/Th $\mu$ s
Line-to-earth:	2	kV (charge voltage)
Line-to-line:	1	kV (charge voltage)
<b>Atmospheric Conditions:</b>		
<b>Temp:</b> 23°C	<b>Humidity:</b> 42%	<b>Pressure:</b> 1022mbar
<b>Test Points:</b>		
<b>AC mains:</b>	<b>Pass/Fail</b>	<b>Comments:</b>
L1-L2	Pass	
L1-L3	Pass	
L2-L3	Pass	
L1-PE	Pass	
L2-PE	Pass	
L3-PE	Pass	

Power-Frequency Magnetic Field					
<b>Work Order:</b> D0704			<b>Table:</b> 17		
<b>Date:</b> 18-Sep-03					
<b>Engineer:</b> Jia-Lin Fu					
<b>EUT:</b> SYAF16KI					
<b>Company:</b> APC					
<b>Modifications since start date:</b> See Modifications					
<b>Testing Location:</b> 527 Great Road - Main Building, Littleton, MA 01460					
<b>Performance Criteria:</b> A					
<b>Frequency:</b> 50 Hz					
<b>Maximum Test Parameters:</b> 3 A/m					
<b>Atmospheric Conditions:</b>					
<b>Temp:</b> 23°C		<b>Humidity:</b> 42%		<b>Pressure:</b> 1022mbar	
<b>Orthogonal Axes Tested:</b>					
<u><b>Front</b></u>	<u><b>Back</b></u>	<u><b>Right</b></u>	<u><b>Left</b></u>	<u><b>Top to Bottom</b></u>	
Pass	Pass	Pass	Pass	Pass	<b>Pass/Fail</b>

**Diagnostic Test Result**

AC Mains Conducted Emissions											Curtis-Straus LLC	
Date: 15-Sep-03			Company: APC Corporation NPS Division						Table No: 18			
Engineer: Matt Deeter			EUT Desc: SYAF16KI						Work Order: D0704			
Notes: 50% Load Charging											Test Site: EMI2	
LISN(s): White-Black Black Red-Black Blue-Black												
Range: 0.15-30Mhz			Other Equipment: ---				Spectrum Analyzer: Blue					
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor	FCC A Applicable until July 12, 2004		FCC/CISPR A		FCC/CISPR A		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB	
Line 1					---	---	---	---	---	---	---	---
0.15	49.1		35.8		20.0	---	---	79.0	-9.9	66.0	-10.2	Pass
0.17	39.2		30.5		20.0	---	---	79.0	-19.8	66.0	-15.5	Pass
0.92	10.0				20.0	60.0	-30.0	73.0	-43.0	60.0	-30.0	Pass
1.62	20.7		14.0		20.0	60.0	-32.3	73.0	-32.3	60.0	-26.0	Pass
3.73	17.4		16.6		20.0	69.5	-32.1	73.0	-35.6	60.0	-23.4	Pass
4.46	27.4		21.7		20.0	69.5	-22.1	73.0	-25.6	60.0	-18.3	Pass
9.52	21.2		17.2		20.0	69.5	-28.3	73.0	-31.8	60.0	-22.8	Pass
26.76	16.9		13.9		20.0	69.5	-32.6	73.0	-36.1	60.0	-26.1	Pass
29.73	21.0		19.3		20.0	69.5	-28.5	73.0	-32.0	60.0	-20.7	Pass
Line 2					---	---	---	---	---	---	---	---
0.15	60.5		44.2		20.0	---	---	79.0	1.5	66.0	-1.8	Fail
0.17	54.9		44.2		20.0	---	---	79.0	-4.1	66.0	-1.8	Pass
1.64	21.4		16.3		20.0	60.0	-18.6	73.0	-31.6	60.0	-23.7	Pass
3.50	26.0		18.1		20.0	69.5	-36.5	73.0	-27.0	60.0	-21.9	Pass
4.66	25.0		18.5		20.0	69.5	-37.5	73.0	-28.0	60.0	-21.5	Pass
8.12	31.4		21.4		20.0	69.5	-31.1	73.0	-21.6	60.0	-18.6	Pass
29.69	12.6				20.0	69.5	-36.9	73.0	-40.4	60.0	-27.4	Pass
29.74	9.8				20.0	69.5	-39.8	73.0	-43.3	60.0	-30.3	Pass
Line 3					---	---	---	---	---	---	---	---
0.15	59.8		44.6		20.0	---	---	79.0	0.8	66.0	-1.4	Fail
0.17	54.6		43.5		20.0	---	---	79.0	-4.4	66.0	-2.5	Pass
1.65	21.9		16.2		20.0	60.0	-18.1	73.0	-31.1	60.0	-23.8	Pass
4.62	20.2		13.5		20.0	69.5	-42.3	73.0	-32.8	60.0	-26.5	Pass
7.72	24.3		13.5		20.0	69.5	-38.2	73.0	-28.7	60.0	-26.5	Pass
8.15	27.4		18.6		20.0	69.5	-35.1	73.0	-25.6	60.0	-21.4	Pass
26.76	10.9		8.4		20.0	69.5	-38.7	73.0	-42.2	60.0	-31.6	Pass
29.74	19.0		18.2		20.0	69.5	-30.5	73.0	-34.0	60.0	-21.8	Pass
Table Result: Fail by 1.49 dB Worst Freq: 0.15 MHz												

### ***Test Configuration Photographs***



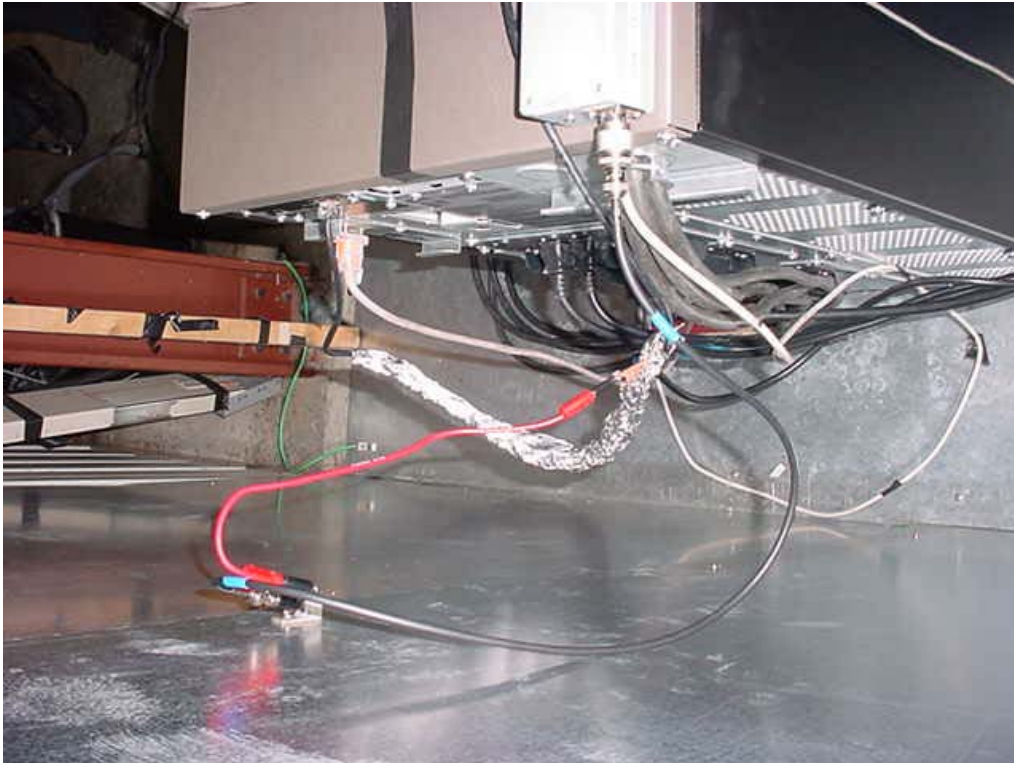
**Radiated Emissions (Front)**



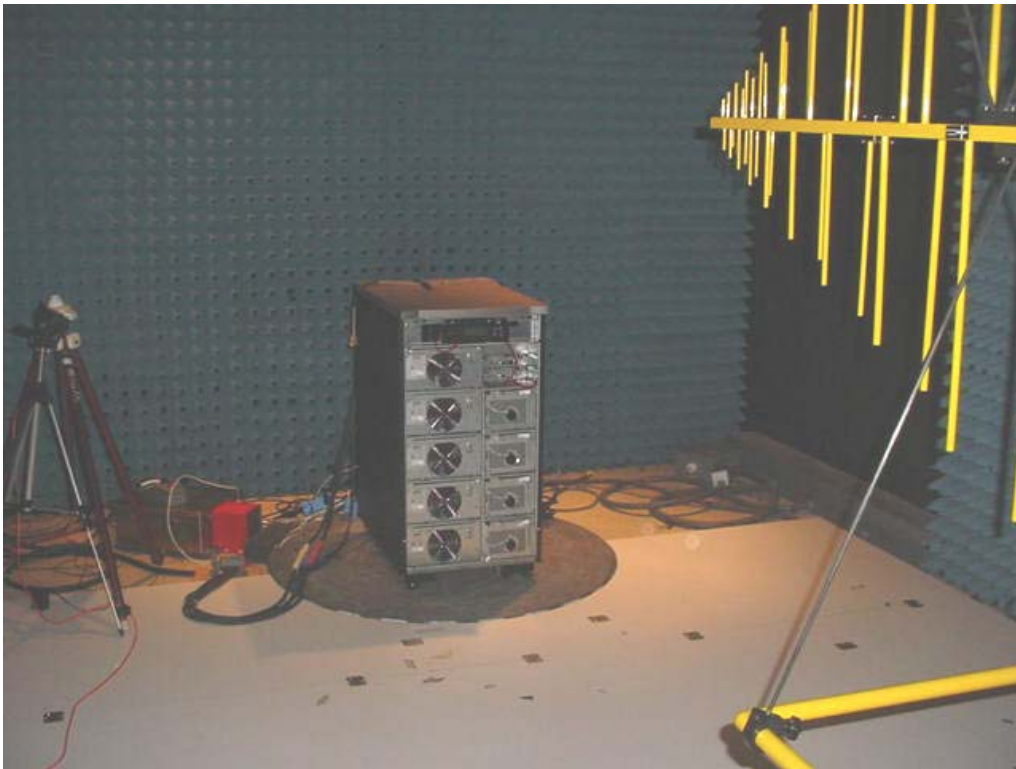
**Radiated Emissions (Rear)**



AC Conducted Emissions



Telco Emissions



RFI



EFT

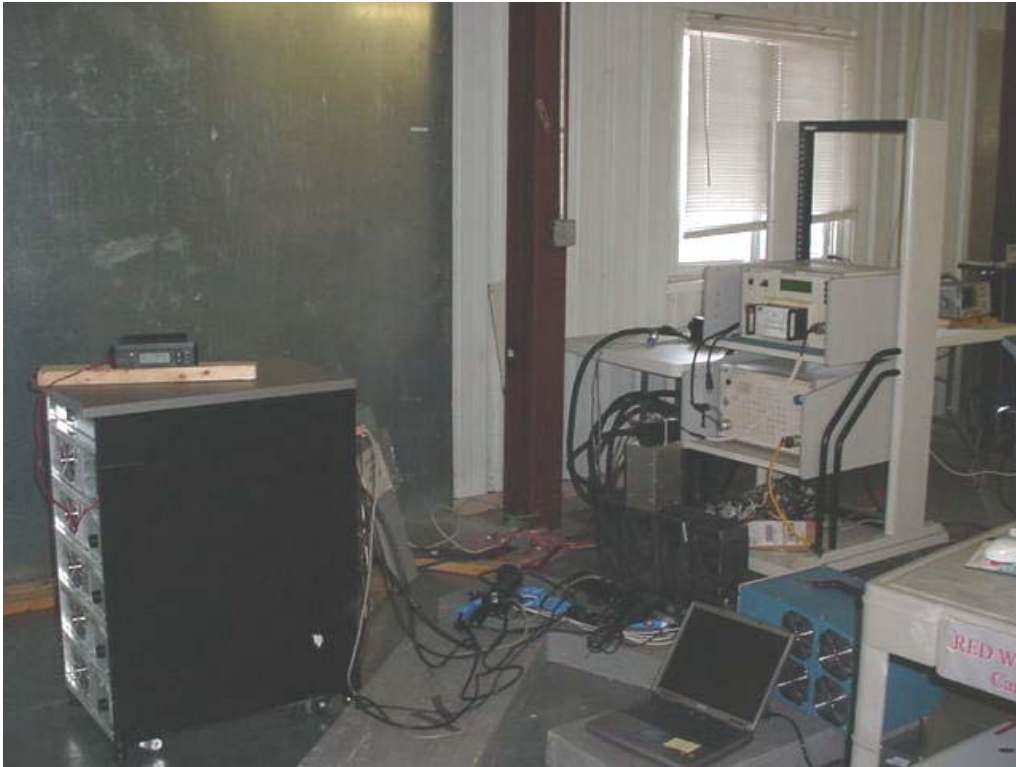




ESD



CRFI



AC Surge



Magnetic Immunity



## Test Descriptions

### Radiated Emissions Testing Overview

REV 25-Oct-02

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 the 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 it is required that the radiated RF signals from the device are 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 are made of the radiated energy 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. Thus the emitted energy may vary with changes in operating mode, physical configuration, or orientation. During measurements these parameters are varied to confirm that the device will remain below the allowable emissions level in the range of typical installations.

To the person actually experiencing the affect of interference, the level of annoyance created 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 intermittent brief louder 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 rise time and a slow fall 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 C63.4:1992 and CISPR 22:1998.

The test site for the emissions measurements follows the format developed internationally for an 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. At the two foci of the ellipse is the equipment under test (EUT) and the measuring antenna, respectively. 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 C63.4:1992. 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 certain amount of signal is put into the transmitting antenna a lesser amount of signal ought to be measured at the receive antenna. The loss of signal is known as the site attenuation and should follow a predicted curve. If it doesn't, then there is something wrong with either the equipment used or with 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 C63.5:1988. Emissions are measured with the measurement 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 mast to support the antennas is capable of a 1 to 4 meter height range. The measurement 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 located on a large 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 would 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 the noise floor at six representative frequencies is 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.

<b>FCC frequency range of radiated emissions measurements</b>	
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 <sup>th</sup> 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:

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

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

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

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 25-OCT-02

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 C63.4:1992 and CISPR 22:1998.

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.

<b>Line Conducted Emissions Limits: Class A (dBµV)</b>		
Frequency (MHz)	Quasi-Peak	Average
0.15 - 0.5	79	66
0.5 - 30	73	60
<b>Line Conducted Emissions Limits: Class B (dBµV)</b>		
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		

Although the FCC is now accepting the limits shown above, it should be noted that the former FCC limits may be used until July 11, 2005 for any equipment authorized prior to July 12, 2004. 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.

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

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

For tabletop equipment the measurement is performed with the equipment 40 cm from the horizontal ground plane under the product. The ground plane extends 0.5 meters beyond the product and is 2.5mx3.7m in size. For shielded cables, the shield of the cable under test is terminated to the ground plane via a 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 3-May-00

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.

The generic immunity standard for residential, commercial and light industrial environments EN 50082-1 specifies the IEC 801-3:1984 test methodology and applies a field intensity level of 3 V/m in the frequency range of 27 to 500 MHz. This field, which corresponds to Severity Level 2 as specified in IEC 801-3:1984, is generated as a continuous wave, without modulation. These field levels, while generally lower than accepted safe human exposure levels, can cause harmful interference to communications and other electronics. For these reasons, 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. There is no specific requirements for field uniformity in IEC 801-3:1984.

The generic heavy industrial immunity specification EN 50082-2 specifies the ENV50140 and ENV 50204 test methodologies. These have been superseded by the EN61000-4-3 standard. 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. This field, which corresponds to Severity Level 3 as specified in IEC 1000-4-3, is generated with 1kHz 80% depth amplitude modulation. In addition, the frequency range of 895-905 MHz is re-swept with 200 Hz square wave 100% depth modulation. These field levels, while generally lower than accepted safe human exposure levels, can cause harmful interference to communications and other electronics. For these reasons, 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 an RF absorber lined shielded enclosure. The uniformity of the field is  $\pm 3\text{dB}$ .

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.

Power is applied to the EUT in its normal operating condition either through an AC power cord or 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 lengths prohibit placement of the TSE outside the enclosure, they are 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 to monitor front panel indicators or other performance indications. The TV monitor can be located outside the enclosure and the EUT is observed for performance deviations during all tests.

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 in both horizontal and vertical polarization. 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 801-3:1984 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 27 to 500 MHz at a rate of approximately 10 minutes per octave (.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 IEC 1000-4-3, 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 tests are performed with the antennas in both horizontal and vertical polarization.

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. This test method is covered by our A2LA accreditation.

## Electrostatic Discharge Testing Overview

REV 3-May-00

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. While IEC 801-2:1984 is technically called out in EN 50082-1, most manufacturers and test labs have migrated to the newer IEC 801-2:1991/IEC 1000-4-2:1995 as the 1984 first edition is clearly and critically out of date. The model currently selected for use in the EU is 330 Ohm/150 pF, usually with a charge voltage of 4kV contact mode/ 8 kV air discharge mode.

IEC 1000-4-2 is the basic procedure for ESD testing. The preferred discharge method specified in IEC 1000-4-2 is referred to as "contact discharge". In this method, a charged internal 150pF capacitor is isolated from the probe tip by a mechanical relay (typically filled with sodium hexafluorine gas). The tip is applied to a nearby metal surface or metal points on the product that the user may touch. The relay is then closed and the arc occurs within the relay, transferring the charge on the cap down the tip. If the product has insulated surfaces, then the "air discharge" method is also employed. In this method the relay is closed while the tip is at a great distance from the product. The tip is then brought to the insulated parts of the product at high speed. If an arc over occurs (though the insulation or more typically through cracks or slots) then that area is subject to more ESD stimulation.

For air discharge the high approach speed is especially important. As the length of the ionized air gap changes, it is necessary to control this variable. Some control can be exerted by

making the discharge electrode approach the device under test at high speed. This high approach speed makes test results more repeatable because it reduces the variability of the discharge impedance.

The test site is assembled on top of a ground plane made of overlapping galvanized steel sheets 2.5m x 3.5m. The ground plane is connected to safety earth. Table top equipment is tested on an .8mx1.6m non-conductive table placed on this ground plane. If the tabletop system is especially large a second, separate table is added to support the additional equipment. A sheet of galvanized steel is placed on the tabletop. This plate is connected to the lower ground plane by a wire with 470k Ohm resistors at each end. The plate is called the Horizontal Coupling Plane (HCP). An additional .5mx.5m galvanized steel plate is used as a Vertical Coupling Plane (VCP). The VCP is also connected to the lower ground plane via a wire with 470k Ohm resistors at each end. Tabletop EUTs are isolated from the HCP by an insulator <.5mm thick. Typically a plastic sheet is employed. Floor standing equipment is tested on a 10cm insulator on top of the ground plane. For floor standing EUT configurations which do not have a tabletop component, an HCP is not part of the test setup as the ground plane is not an HCP. The EUT is grounded as normally installed.

The test begins with discharges to the HCP (if present) and VCP. All discharges are applied only in the contact discharge mode. 10 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. 10 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.

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. IEC 1000-4-2 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%. This test method is covered by our A2LA accreditation.

## Electrical Fast Transient Burst Testing Overview

REV 3-May-00

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 IEC 801-4:1988/ IEC 1000-4-4:1994. 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 (IEC 801-4) 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.

IEC 801-4 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 EN50091-2:1996, 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.

IEC 801-4:1984 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 3-May-00

At the 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, IEC 1000-4-6 has set a level of 1 V open circuit as equivalent to 1 V/m.

The EUT is configured on a .1 m high non-conductive platform over a ground plane which extends at least .5 meters beyond the edge of the EUT. All vertical conducting surfaces are at a distance of at least .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 a 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 EUTs, not all possible conduction paths are explored. In accordance with IEC 1000-4-6,  $n$  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 3-May-00

Power lines are subjected to surges which result primarily from lightning events. Typical lightning waveforms, are specified in IEC standard 1000-4-5:1995. The transients specified are double exponential waveforms with a rise time of 1.2  $\mu$ S and a pulse width of 50  $\mu$ S (open circuit). The short circuit waveform is an 8 x 20  $\mu$ S double exponential. The usual level for longitudinal common mode injection AC power ports is 2 kV open circuit with a short circuit current of 1 kA. In the differential mode (between phase and neutral) the peak level is limited to 1 kV. The surges are injected in both positive and negative polarities into the AC line at phase angles between 0 and 360°. A CDI M5 Universal Surge Generator™ is used to generate the appropriate waveshapes and amplitudes.

For the IEC 1000-4-5 test method, 5 repetitions are applied in each polarity and at the 0, 90, 180, and 270 points of the AC cycle. Surges are applied from each line to ground using a 12 Ohm source impedance and from each line to every other line combination (including neutral) using a 2 Ohm source impedance.

DC power ports and some signal lines are also subjected to 1.2 x 50  $\mu$ S lightning surges. In this case, however, the peak voltage is usually limited to 500 volts in both common and differential mode.

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.

{*IF Harmonics*, insert file "\\Testing\curtis-strau\ EMC Modules"}

{*IF Flicker*, insert file "\\Testing\curtis-strau\ EMC Modules"}



## Test Equipment Used

REV. 9/11/03

<b>SPECTRUM ANALYZERS</b>	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
RED	9kHz-1.8GHz	8591E	HP	3441A03559	00024	21-MAY-2004
WHITE	9kHz-22GHz	8593E	HP	3547U01252	00022	25-FEB-2004
BLUE	9kHz-1.8GHz	8591E	HP	3223A00227	00070	04-OCT-2003
YELLOW	9kHz-2.9GHz	8594E	HP	3523A01958	00100	08-JUL-2004
GREEN	9kHz-26.5GHz	8593E	HP	3829A03618	00143	02-OCT-2003
BLACK	9kHz-12.8GHz	8596E	HP	3710A00944	00337	15-JUL-2004
YELLOW-BLACK	20Hz-40.0MHz	3585A	HP	2504A05219	00030	25-NOV-2003
ORANGE	9kHz-26.5GHz	E4407B	HP	US39440975	00394	27-JUN-2004

<b>LISNs/MEASUREMENT PROBES</b>	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
RED	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	956348	00753	01-APR-2004
BLUE	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	956349	00752	01-APR-2004
YELLOW-BLACK	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	984735	00248	01-APR-2004
ORANGE	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	903707	00754	24-OCT-2003
GOLD	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	984734	00247	24-JUL-2004
WHITE-BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972019	00678	01-APR-2004
BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972017	00675	01-APR-2004
RED-BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972016	00677	01-APR-2004
BLUE-BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972018	00676	01-APR-2004
BLUE MONITORING PROBE	0.01-150MHz	91550-2	TEGAM	12350	00807	21-MAY-2005
YELLOW MONITORING PROBE	0.01-150MHz	91550-2	ETS	50972	00493	21-NOV-2003
GREEN CURRENT TRANSFORMER	40Hz-20MHz	150	PEARSON	10226	00793	03-APR-2004
CISPR LINE PROBE	150kHz-30MHz	N/A	C-S	01	00805	20-DEC-2004
CISPR TELCO VOLTAGE PROBE	150kHz-30MHz	CS A/C-10	C-S	CS01	00296	11-SEP-2004
CISPR 22 TELCO ISN	9kHz-30MHz	FCC-TLISN-T4	FISCHER	20115	00746	15-OCT-2003

<b>OPEN AREA TEST SITE (OATS)</b>	FCC CODE	IC CODE	VCCI CODE	CALIBRATION DUE
SITE F	93448	IC 2762-F	R-468	25-MAR-2005
SITE T	93448	IC 2762-T	R-905	25-MAR-2005
SITE A	93448	IC 2762-A	R-903	25-MAR-2005
SITE M	93448	IC 2762-M	R-904	25-MAR-2005
BUBBLE (HP FACILITY)	N/A	N/A	R-1467	16-MAY-2005

<b>LINE CONDUCTED TEST SITES</b>	FCC CODE	IC CODE	VCCI CODE	CALIBRATION DUE
EMI 1	93448	N/A	C-480	01-MAY-2006
EMI 2	93448	N/A	C-480	01-MAY-2006
EMI 3	93448	N/A	C-480	01-MAY-2006
BUBBLE (HP FACILITY)	N/A	N/A	C-1556	16-MAY-2005

<b>ANTENNAS</b>	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
GREEN BILOG	30MHz-2GHz	CBL6112B	CHASE	2742	00620	19-MAY-2005
GREEN-BLACK BILOG	30MHz-2GHz	CBL6112B	CHASE	2412	00127	19-MAY-2005
GREEN-WHITE BILOG	30MHz-2GHz	CBL6112B	CHASE	2574	00319	19-MAY-2005
RED BILOG	30MHz-1GHz	3143	EMCO	1270	00042	17-MAR-2005
BLUE BILOG	30MHz-1GHz	3143	EMCO	1271	00803	17-MAR-2005
GRAY BILOG	26MHz-2GHz	3141	EMCO	9703-1038	00066	19-MAY-2005(EMI) / 06-JUN-2004(RFI)
YELLOW-BLACK BILOG	20-2000MHz	CBL6140A	CHASE	1112	00126	19-MAY-2005(EMI) / 09-JUN-2004(RFI)
YELLOW HORN	1-18GHz	3115	EMCO	9608-4898	00037	22-MAY-2005
BLACK HORN	1-18GHz	3115	EMCO	9703-5148	00056	12-JUN-2005
ORANGE HORN	1-18GHz	3115	EMCO	0004-6123	00390	04-JUN-2005
HF (WHITE) HORN	18-26.5GHz	801-WLM	WAVELINE	00758	00758	15-JUL-2005
SMALL LOOP	9kHz-30MHz	PLA-130/A	ARA	1024	00755	27-JAN-2004
LARGE LOOP	20Hz-5MHz	6511	EMCO	9704-1154	00067	05-NOV-2003
ACTIVE MONOPOLE	30Hz-30MHz	3301B	EMCO	3824	00068	08-APR-2004
INDUCTION COIL	50-60Hz	1000-4-8	C-S	N/A	00778	16-SEP-2004
ADJUSTABLE DIPOLE	30-1000MHz	3121C	EMCO	1370	00757	26-JUN-2005

ADJUSTABLE DIPOLE	30-1000MHz	3121C	EMCO	1371	00756	26-JUN-2005
RE101 LOOP SENSOR	30Hz-100kHz	RE101-13.3CM	C-S	N/A	00818	07-JAN-2005
RS101 RADIATING LOOP	30Hz-100kHz	RS101-12CM	C-S	N/A	00819	07-JAN-2005
RS101 LOOP SENSOR	30Hz-100kHz	RS101-4CM	C-S	N/A	00820	07-JAN-2005

MIXERS/DIPLEXERS	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
MIXER / HORN	26.5-40 GHz	11970A/28-442-6	HP/ATM	2332A00900/A046903-01	00369	09-JUL-2004
MIXER / HORN	40-60 GHz	M19HW/A	OML	U30110-1	00821	03-JAN-2005
MIXER / HORN	60-90 GHz	M12HW/A	OML	E30110-1	00822	03-JAN-2005
MIXER / HORN	90-140 GHz	MO8HW/A	OML	F21206-1	00811	05-DEC-2004
MIXER / HORN	140-220 GHz	MO5HW/A	OML	G21206-1	00812	05-DEC-2004
DIPLEXER		DPL.26	OML	N/A	00813	05-DEC-2004

PREAMPS / ATTENUATORS / FILTERS	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
RED	0.10-2000MHz	ZFL-1000-LN	C-S	N/A	00798	17-MAR-2004
BLUE	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00759	31-JUL-2004
BLUE-BLACK	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00800	08-APR-2004
GREEN	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00802	17-MAR-2004
BLACK	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00799	17-MAR-2004
ORANGE	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00765	17-MAR-2004
WHITE	1-20GHz	SMC-12A	C-S	426643	00760	29-JUL-2004
YELLOW-BLACK	1-20GHz	SMC-12A	C-S	535055	00801	19-AUG-2004
ORANGE-BLACK	1-20GHz	SMC-12A	C-S	637367	00761	29-JUL-2004
HF (YELLOW)	18-26.5GHz	AFS4-18002650-60-8P-4	C-S	467559	00758	15-JUL-2004
HIGH PASS FILTER	1-18 GHz	SPA-F-55204	K&L	36	00817	31-DEC-2003
LOW PASS FILTER	1-9 GHz	11SL10-4100/X4400-O/O	K&L	4	00816	31-DEC-2003
HF 20dB ATTENUATOR	0.03-20 GHz	PE 7019-20	PASTERNAK	01	00791	21-MAY-2005

ABSORBING CLAMPS	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
FISCHER CLAMP	30-1000MHz	F-201-23MM	FISCHER	10	00081	04-JAN-2004

EFT	MN	MFR	SN	ASSET	CALIBRATION DUE
EFT DIRECT COUPLING CAP	N/A	C-S	01	00794	10-DEC-2003

ESD GENERATORS	MN	MFR	SN	ASSET	CALIBRATION DUE
GREEN	NSG435	SCHAFFNER	000839	00763	04-NOV-2003
RED	NSG435	SCHAFFNER	001625	00762	15-NOV-2003
YELLOW	930D	ETS	201	00673	11-JUN-2004

BEST EMC-2	MN	MFR	SN	ASSET	CALIBRATION DUE
BLUE	711-1100	SCHAFFNER	199824-002SC	00117	16-JUN-2004 (SURGE) / 04-OCT-2003 (EFT, D+I)
RED	711-1100	SCHAFFNER	200122-074SC	00623	17-JUN-2004 (SURGE) / 04-OCT-2003 (EFT, D+I)

CHAMBERS AND STRIPLINE	MN	MFR	SN	ASSET	CALIBRATION DUE
RFI 1 CHAMBER	3 METER COMPACT	PANASHIELD	N/A	00797	09-JUN-2004
RFI 2 CHAMBER	04' x 07' SHIELDING SYSTEM	LINDGREN	13329	00795	06-JUN-2004
RFI 3 STRIPLINE	N/A	C-S	N/A	00796	22-JUL-2005
ENVIRONMENTAL (SAFETY)	SGTH-31S	B-M-A INC.	2245	00321	03-JAN-2004

AMPLIFIERS	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
RED	0.5-1000MHz	10W1000B	AR	18708	00032	12-MAY-2004
GREEN	0.5-1000MHz	10W1000B	AR	23423	00123	24-MAY-2004
BLUE	0.01-250MHz	75A250	AR	19165	00039	14-JAN-2004(CRFI) / 12-MAY-2004 (RFI)
BLACK	0.01-250MHz	75A250	AR	23411	00122	14-JAN-2004(CRFI) / 28-MAY-2004(RFI)
ORANGE	0.01-250MHz	75A250	AR	26827	00367	14-JAN-2004(CRFI) / 28-MAY-2004(RFI)
HP489A	1.0-2.0GHz	HP489A	HP	1144AU1780	00083	16-OCT-2003

HP491C	2.0-4.0GHz	HP491C	HP	449-00638	00764	16-OCT-2003
HP493A	4.0-8.0GHz	HP493A	HP	171402242	00085	16-OCT-2003
HP495A	7.0-12.0GHz	HP495A	HP	904-00237	00086	16-OCT-2003

<b>FIELD PROBES</b>	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
RED	0.01-1000MHz	HI-4422	HOLADAY	90369	00031	14-APR-2004
GREEN	0.01-1000MHz	HI-4422	HOLADAY	97363	00136	02-APR-2004

<b>SIGNAL GENERATORS</b>	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
RED	0.09-2000MHz	HP8648B	HP	3847U02192	00366	11-DEC-2003
BLUE	0.1-1000MHz	HP8648A	HP	3426A00548	00034	15-JUL-2004
GREEN	0.09-2000MHz	HP8648B	HP	3623A02072	00125	10-SEP-2004
ORANGE	0.1-1000MHz	HP8648B	HP	3537A01210	00025	21-MAY-2004
BLACK	15MHz	HP33120A	HP	US36004674	00766	23-OCT-2003
YELLOW	15MHz	HP33120A	HP	US36014119	00249	21-MAY-2004
BLUE-WHITE	0.1Hz-13MHz	HP3312A	HP	1432A07632	00775	27-FEB-2004
SWEEPER	0.01-20.0GHz	HP83752A	HP	3610A01133	00087	04-APR-2004

<b>BULK INJECTION CLAMPS</b>	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
RED	0.01-100MHz	95236-1	TEGAM	12248	00035	14-JAN-2004
GREEN	0.01-100MHz	95236-1	EMCO	50215	00118	14-JAN-2004

<b>CDN NETWORKS</b>	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
BLACK	0.15-100MHz	20A M-2	C-S	04	00783	14-JAN-2004
BLUE	0.15-100MHz	15A M-3	C-S	05	00806	14-JAN-2004
RED	0.15-100MHz	15A M-3	C-S	06	00780	14-JAN-2004
WHITE	0.15-100MHz	15A M-3	C-S	07	00782	14-JAN-2004
YELLOW-BLACK	0.15-100MHz	15A M-3	C-S	08	00784	14-JAN-2004
BLUE-BLACK	0.15-100MHz	15A M-3	C-S	09	00781	14-JAN-2004
GREEN	0.15-100MHz	30A M-3	C-S	10	00779	14-JAN-2004
YELLOW	0.15-100MHz	30A M-5	C-S	11	00804	14-JAN-2004
BLUE-WHITE	0.15-100MHz	15A M-5	C-S	12	00788	14-JAN-2004
YELLOW (RES)	0.15-100MHz	100Ω RESISTOR Nwk	C-S	01	00810	10-SEP-2004
GREEN (RES)	0.15-100MHz	100Ω RESISTOR Nwk	C-S	02	00785	10-SEP-2004

<b>HARMONIC ANALYZER</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
HFTS	HP6842A	HP	3531A-00169	00738	29-OCT-2003

<b>FREQUENCY COUNTER</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
5340A	HP5340A	HP	1440A02320	00787	30-JUL-2004

<b>SURGE GENERATORS</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
TRANSIENT WAVEFORM MONITOR	TWM-5	CDI	003982	00323	18-JUN-2004
UNIVERSAL SURGE GENERATOR	M5	CDI	003966	00324	13-JUN-2004
THREE PHASE COUPLING Nwk	3CN	CDI	003455	00325	13-JUN-2004
1.2x50uS PLUGIN MODULE	1.2x50uS PLUGIN	CDI	N/A	00842	13-JUN-2004
10x160uS PLUGIN MODULE	10x160uS PLUGIN	C-S	N/A	00843	12-JUN-2004
10x560uS PLUGIN MODULE	10x560uS PLUGIN	C-S	N/A	00841	12-JUN-2004
10x700uS PLUGIN MODULE W/ EXTENSION BOX	10x700uS PLUGIN	C-S	N/A	00844/845	12-JUN-2004
PSURGE CONTROLLER MODULE	PSURGE 8000	HAEFELY	150267	00879	11-JUN-2004
COUPLING/DECOUPLING MODULE	PSD 900	HAEFELY	149213	00880	11-JUN-2004
IMPULSE MODULE	PIM 900	HAEFELY	149202	00881	11-JUN-2004
HIGH VOLTAGE CAP Nwk 5kVDC, 18uF	CS-HVCC	C-S	01	00772	15-OCT-2003
NEBS SURGE GENERATOR	N/A	C-S	N/A	00088	17-JUN-2004
2x10uS SURGE GENERATOR	2x10uS	C-S	N/A	00846	18-JUN-2004
10x700uS SURGE GENERATOR	10x700uS	C-S	N/A	00847	12-JUN-2004
12 PAIR SURGE RESISTOR MODULE	N/A	C-S	N/A	00768	05-OCT-2003

<b>OSCILLOSCOPES</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
OSCILLOSCOPE 100MHZ	TDS 220	TEKTRONIX	B068748	00885	03-JUN-2004
OSCILLOSCOPE 100MHZ (SAFETY)	TDS 340	TEKTRONIX	B012357	00737	18-OCT-2003
OSCILLOSCOPE 100MHZ (TELECOM)	54645A	HP	US36320452	00103	30-JUN-2004

<b>POWER SUPPLIES</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
-----------------------	----	-----	----	-------	-----------------

10001 1/2 AC POWER SYSTEM	(2) 500i	CALIFORNIA INSTRUMENTS	HK53687/HK53688	00376	31-DEC-2003
<b>RMS VOLTMETERS/CURRENT CLAMP</b>	MN	MNFR	SN	ASSET	CALIBRATION DUE
RED RMS VOLTMETER	3400A	HP	40102044	00770	04-OCT-2003
WHITE RMS VOLTMETER	3400A	HP	1218A14427	00809	09-DEC-2003
GREEN RMS VOLTMETER (TELECOM)	3400A	HP	806-09594	00344	10-DEC-2003
TRUE-RMS VOLTMETER	79III	FLUKE	71700298	00769	03-OCT-2003
TRUE-RMS CLAMP METER (SAFETY)	36	FLUKE	68805882	00700	31-MAR-2004
<b>POWER/NOISE METERS</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
POWER METER	435B	HP	2445A11012	00773	07-APR-2004
POWER SENSOR	8481A	HP	2702A61351	00774	07-APR-2004
TRANSMISSION LINE TESTER (DBRNC)	185T	AMREL	998658	00823	14-JAN-2004
<b>OVERVOLTAGE CHAMBERS</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
72kW POWER FAULT SIMULATOR	OV1	C-S	N/A	00792	14-MAR-2004
POWER FAULT SIMULATOR	OV2	C-S	N/A	00116	14-MAR-2004
<b>DIPOLE TAPE MEASURES</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
26FT TAPE #1	2338CME	LUFKIN	C3166-1	00776	26-FEB-2005
26FT TAPE #2	2338CME	LUFKIN	C3166-2	00777	26-FEB-2005
<b>METEOROLOGICAL METERS</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
TEMPERATURE /HUMIDITY GAUGE	THG-912	HUGER	4000562	00789	08-NOV-2003
ATMOSPHERIC PRESSURE GAUGE	BA928	OREGON SCIENTIFIC	C3166-1	00831	03-MAR-2004
<b>TRACEABLE CLOCKS</b>	MN	MFR	SN	ASSET	CALIBRATION DUE
5003	5003	CONTROL COMPANY	99026940	00808	09-DEC-2003
<b>CONSUMABLES</b>	SPEC.	MFR	STOCK/MN	ASSET	CALIBRATION DUE
NEBS CHEESE CLOTH	26-28M/KG	ED&D	ACC-01	N/A	N/A
NEBS CARBON BLOCK	3-MIL-GAP 1kV SURGE	RELIABLE	3AB	N/A	N/A

Unless otherwise noted the calibration interval is one year. All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

***Product Documentation***

If additional documentation on the product has been provided for insertion in the report, it is appended here.

## ***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.

## FCC Requirements

### Required Equipment Authorization for Device Type

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

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

Verified devices must have the following label permanently affixed in a location accessible to the user:

*This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

No distinction is made between Class A or Class B devices on the label.

When the device is so small or for such use that it is not practicable to place label on it, the information may be shall be placed in a prominent location in the instruction manual supplied to the user or, alternatively, shall be placed on the container in which the device is marketed.

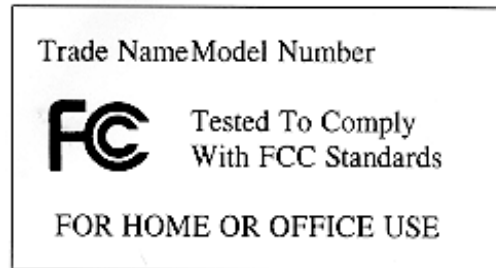
Where a device is constructed in two or more sections connected by wires and marketed together, the label is only required to be affixed to the main control unit.

**FCC Required labeling for Class B Personal Computers and Peripherals Devices  
47 CFR Part 15.19 subject to Declaration of Conformity**

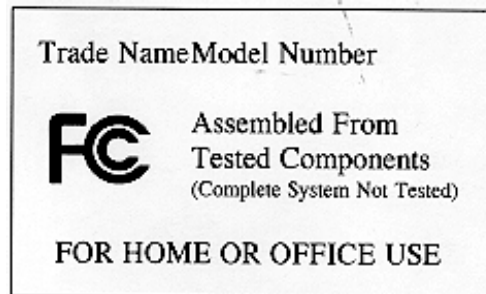
Personal computers and peripherals subject to authorization under a Declaration of Conformity shall be labeled as follows:

(1) The label shall be located in a conspicuous location on the device and shall contain the unique identification described in Section 2.1074 and the following logo:

(i) If the product is authorized based on testing of the product or system:



(ii) If the product is authorized based on assembly using separately authorized components and the resulting product is not separately tested:



(2) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (b)(1) of this section on it, such as for a CPU board or a plug-in circuit board peripheral device, the text associated with the logo may be placed in a prominent location in the instruction manual or pamphlet supplied to the user. However, the unique identification (trade name and model number) and the logo must be displayed on the device.

(3) The label shall not be a stick-on, paper label. The label on these products shall be permanently affixed to the product and shall be readily visible to the purchaser at the time of purchase, as described in Section 2.925(d). "Permanently affixed" means that the label is etched, engraved, stamped, silk-screened, indelibly printed, or otherwise permanently marked on a permanently attached part of the equipment or on a nameplate of metal, plastic, or other material fastened to the equipment by welding, riveting, or a permanent adhesive. The label



must be designed to last the expected lifetime of the equipment in the environment in which the equipment may be operated and must not be readily detachable.

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

The user's manual must caution the user that changes or modifications not expressly approved by the manufacturer could void the user's FCC granted authority to operate the equipment. In addition the following information should be inserted:

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

*Note: this equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

*Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

(c) The provisions of paragraphs (a) and (b) of this section do not apply to digital devices exempted from the technical standards under the provisions of § 15.103.

(d) For systems incorporating several digital devices, the statement shown in paragraph (a) or (b) of this section needs to be contained only in the instruction manual for the main control unit.

## Australian Communications Authority Product Marketing

### Labeling

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

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

### General Labeling Conditions

The label should meet the following specifications:

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

The label may be affixed to a product at any point prior to its being offered for sale on the Australian market. The ACA 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 ACA; 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 ACA. A supplier is only required to submit one application to the ACA advising of their intention to use the C-Tick Mark on all compliant products. The ACA 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 ACA; 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 ACA web site at <http://www.sma.gov.au/> under the heading of EMC framework.

### Canadian Requirements

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

#### For ITE products:

This Class A or B digital apparatus complies with Canadian ICES-003.  
Cet appareil numérique de la classe A or B est conforme a la norme NMB-003 du Canada.

#### For ISM products:

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

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

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

## VCCI Requirements

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

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

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

Curtis-Straus, the measurement facility, is a VCCI supporting member Rank D, acceptance number 818. Our facility codes are C-480, R-468, R-903, R-904 and R-905.

## Terms and Conditions

### Paragraph 1. SERVICES. LABORATORY will:

- 1.1 Use the degree of care and skill ordinarily exercised by and consistent with the standards of the profession.
- 1.2 Perform all technical services in substantial accordance with the generally accepted laboratory principles and practices.
- 1.3 Retain all pertinent records relating to the services performed for a period of three (3) years following submission of the report describing such services, during which period the records will be made available to CLIENT upon reasonable request.

### Paragraph 2. CLIENT'S RESPONSIBILITIES. CLIENT or his authorized representative will:

- 2.1 Provide LABORATORY with all plans, schematics, specifications, addenda, change orders, drawings and other information for the proper performance of technical services.
- 2.2 Designate a person to act as CLIENT's representative with respect to LABORATORY's services to be performed on behalf of the CLIENT; such person or firm to have complete authority to transmit instructions, receive information and data, interpret and define CLIENT's policies and decisions with respect to the LABORATORY's work on behalf of the CLIENT and to order, at CLIENT's expense, such technical services as may be required.
- 2.3 Designate a person who is authorized to receive copies of LABORATORY's reports.
- 2.4 Undertake the following:
  - (a) Secure and deliver to LABORATORY, without cost to LABORATORY, preliminary representative samples of the equipment proposed to require technical services, together with any relevant data.
  - (b) Furnish such labor and equipment needed by LABORATORY to handle samples at the LABORATORY and to facilitate the specified technical services.

### Paragraph 3. GENERAL CONDITIONS:

- 3.1 LABORATORY, by the performance of services covered hereunder, does not in any way assume any of those duties or responsibilities customarily vested in the CLIENT, its employees, or any other party, agency or authority.
- 3.2 LABORATORY shall not be responsible for acts of omissions of any other party or parties involved in the design, manufacture or maintenance of the equipment or the failure of any employee, contractor or subcontractor to undertake any aspect of equipment's design, manufacture or maintenance.
- 3.3 LABORATORY is not authorized to revoke, alter, release, enlarge or release any requirement of the equipment's design, manufacture or maintenance unless specifically authorized by CLIENT or his authorized representative.
- 3.4 THE ONLY WARRANTY MADE BY LABORATORY IN CONNECTION WITH ITS SERVICE PERFORMED HEREUNDER IS THAT IT WILL USE THAT DEGREE OF CARE AND SKILL AS SET FORTH IN PARAGRAPH 1 ABOVE. NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS MADE OR INTENDED FOR SERVICES PROVIDED HEREUNDER.
- 3.5 Where the LABORATORY indicates that additional testing is advisable to obtain more valid or useful data, and where such testing has not been authorized, CLIENT agrees to view such test reports as inconclusive and preliminary.
- 3.6 The LABORATORY will supply technical service and prepare a report based solely on the sample submitted to the LABORATORY by the CLIENT. The CLIENT understands that application of the data to other devices is highly speculative and should be applied with extreme caution.
- 3.7 The LABORATORY agrees to exercise ordinary care in receiving, preserving and shipping (F.O.B. Littleton, MA) any sample to be tested, but assumes no responsibility for damages, either direct or consequential, which arise from loss, damage or destruction of the samples due to the act of examination, modification or testing, or technical services or circumstances beyond LABORATORY's control.
- 3.8 The LABORATORY will hold samples for thirty (30) days after tests are completed, or until the CLIENT's outstanding debts to the LABORATORY are satisfied, whichever is later.
- 3.9 The CLIENT recognizes that generally accepted error variances apply and agrees to consider such error variances in its use of test data.
- 3.10 It is agreed between LABORATORY and CLIENT that no distribution of any tests, reports or analysis other than that described below shall be made to any third party without the prior written consent of both parties unless such distribution is mandated by operation of law. It is agreed that tests, reports, or analysis results may be disclosed to third party auditors of the laboratory at the laboratory facility in the course of accreditation maintenance audits. No reference to reports or technical services of the LABORATORY shall be made in any advertising or promotional literature without the express written permission of the LABORATORY.
- 3.11 The CLIENT acknowledges that all employees of LABORATORY operate under employment contracts with the LABORATORY and CLIENT agrees not to solicit employment of such employees or to solicit information related to other clients from said employees.
- 3.12 In recognition of the relative risks and benefits of the project to both CLIENT and LABORATORY, the risks have been allocated such that the CLIENT agrees, to the fullest extent permitted by law, to limit the liability of the LABORATORY to the CLIENT for any and all claims, losses, costs, damages of any nature whatsoever or claims expenses from any cause or causes, including attorneys' fees and costs and expert witness fees and costs, so that the total aggregate liability of the LABORATORY to the CLIENT shall not exceed \$100,000, or the LABORATORY'S total fee for services rendered on this project, whichever is greater. It is intended that this limitation apply to any and all liability or cause of action however alleged or arising, unless otherwise prohibited by law.

### Paragraph 4. INSURANCE:

- 4.1 LABORATORY shall secure and maintain throughout the full period of the services provided to the CLIENT adequate insurance to protect it from claims under applicable Workmen's Compensation Acts and also shall maintain one million dollars of general liability coverage to cover claims for bodily injury, death or property damage as may arise from the performance of its services.
- 4.2 The CLIENT hereby warrants that it has sufficient insurance to protect its employees adequately under applicable Workmen's Compensation Acts and for bodily injury, death, or property damage.
- 4.3 No insurance of whatever kind or type, which may be carried by either party is to be considered as in any way limiting any other party's responsibility for damages resulting from their operations or for furnishing work and materials.

### Paragraph 5. PAYMENT:

- 5.1 CLIENT shall pay to LABORATORY such fees for services as previously agreed, orally or in writing, within 30 days of presentment of a bill for such services performed. In the event CLIENT ordered, orally or in writing, services but such services were not assigned a rate for billing, such services shall be billed at the LABORATORY's reasonable and customary rate.

- 5.2 CLIENT shall be responsible for all shipping, customs and other expenses related to services provided by LABORATORY to the CLIENT, and shall fully insure any test sample or other equipment provided to LABORATORY by the CLIENT.
- 5.3 Amounts overdue from CLIENT to LABORATORY shall be charged interest at a rate of 1½% per month.

**Paragraph 6. ISO/IEC GUIDE 17025 ADDITIONS:**

- 6.1 CLIENT agrees that this test report will not be reproduced except in full, without written approval from the LABORATORY.
- 6.2 CLIENT agrees that this test report shall not be used to claim product endorsement by A2LA or ANSI or any agency of the U.S. Government.
- 6.3 CLIENT agrees that test results presented herein relate only to the sample tested by the LABORATORY.

**A2LA Accreditation****SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999**

CURTIS-STRAUS  
527 Great Road  
Littleton, MA 01460  
Jon Curtis Phone: 978-486-8880

**ELECTRICAL**

Valid until: October 31, 2003

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

EMC Standards <i>Emissions</i>	Title		
CISPR 22 1997 with amendments 1 and 2	Limits and methods of measurement of radio disturbance characteristics of information technology equipment.	CNS 13439 AS/NZS 1053: 1999	Broadcast receiver and associated equipment Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment.
CNS13438 1994	Limits and methods of measurement of radio interference characteristics of information technology equipment.	CISPR 14 1993	Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and electric apparatus.
EN55022:1994 and 1998	Limits and methods of measurement of radio disturbance characteristics of information technology equipment.	EN 55014 1993, 1997	Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus.
SABS CISPR 22:1997	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement	AS/NZS 1044: 1995	Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus.
Canada ICES-003 1997 AS/NZS 3548 1995	Digital apparatus Australian/New Zealand Standard Limits and methods of measurement of radio disturbance characteristics of information technology equipment		
CISPR 11 1990, 1997	Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.	<i>Immunity</i> CNS13783-1 SABS CISPR 14-1 1993	Household Electrical Appliances Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus Part 1: Emission – Product family standard
EN 55011 1991, 1998	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.	SABS CISPR 14-2 1997	Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus Part 2: Immunity – Product family standard
SABS CISPR 11:1997	Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics Limits and methods of measurement	CISPR 14-2 1996	Immunity requirements for household appliances, tools and similar apparatus.
Canada ICES-001 1998	Industrial, scientific and medical radio frequency generators	CISPR 20 with amendment 3	Limits and methods of measurement of immunity characteristics of sound and television broadcast receivers and associated equipment.
CNS13803 AS/NZS 2064: 1997	Industrial, Scientific and Medical Instrument Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.	EN 55020 1995	Electromagnetic immunity of broadcast receivers and associated equipment.
CSA C108.8 – M1983	Electromagnetic Emission from Data Processing Equipment and Electronic Office Machines	CISPR 24	Information technology equipment – Immunity characteristics – Limits and methods of measurement
CISPR 13 1996, 1998	Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment.	SABS CISPR 24 1997	Information technology equipment – Immunity characteristics – Limits and methods of measurement
EN 55013 1990	Sound and television broadcast receivers and associated equipment: Electromagnetic compatibility. Part 1: Specification for limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment.	AS/NZS 3200.1.2: 1995	Approval and test specification – Medical electrical Equipment – General requirements for safety – Collateral Standard: Electromagnetic compatibility – Requirements and tests.
EN 55013 Amend 12 1994	Limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment. Amendment 12	<i>European Union Basic EMC Standards</i> EN 61000-4-2 1995, 1999	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 2: Electrostatic discharge immunity test – Basic EMC Publication
SABS CISPR 13: 1996	Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment.	EN 61000-4-3 1997, 1998 AS/NZS 61000.4.3 1999	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 3: Radiated, radio-frequency, electromagnetic field immunity test

(A2LA Cert. No. 1627-01) Revised 02/21/02

Page 2 of 9

(A2LA Cert. No. 1627-01) Revised 02/21/02

Page 3 of 9

<p>EN 61000-4-4 1995</p> <p>EN 61000-4-5 1995 AS/NZS 61000.4.5 1999 EN 61000-4-6 1996 AS/NZS 61000.4.6 1999</p> <p>EN 61000-4-8 1994</p> <p>EN 61000-4-11 1994</p> <p>ENV 61000-2-2 1993</p> <p><i>EU Product Family Standards</i> EN 50081-1 1992</p> <p>EN 50081-2 1993</p> <p>EN 50082-1 1992, 1998</p> <p>EN 50082-2 1995</p> <p>EN 61000-6-1 1997</p> <p>EN 61000-6-2 1998</p> <p>EN 50091-2 1996</p> <p>EN 55024 1998</p> <p>EN 55103-1 1997</p> <p>EN 55103-2 1997</p> <p>(A2LA Cert. No. 1627-01) Revised 02/21/02</p>	<p>Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 4: Electrical fast transient/burst immunity test – Basic EMC publication</p> <p>(EMC) Part 4: Testing and measurement techniques. Section 5: Surge immunity test.</p> <p>Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 6: Immunity to conducted disturbances, induce by radio-frequency fields</p> <p>Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 8: Power frequency magnetic field immunity test.</p> <p>(EMC) Part 4: Testing and measurement techniques. Section 11: Voltage dips, short interruptions and voltage variations immunity tests.</p> <p>Electromagnetic compatibility (EMC). Part 2: Environment, Section 2: Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage power supply systems (IEC 1000-2-2:1990)</p> <p>Electromagnetic capability – Generic emission standard. Part 1: Residential, commercial and light industry. (I.S.)</p> <p>Electromagnetic compatibility – Generic emission standard. Part 2: Industrial environment</p> <p>Electromagnetic compatibility – Generic emission standard. Part 1: Residential, commercial and light industry</p> <p>Electromagnetic compatibility – Generic immunity Standard. Part 2: Industrial environment</p> <p>Electromagnetic Compatibility (EMC)- Part 6: Generic standards- Section 1: Immunity for residential, commercial and light-industrial environments</p> <p>Electromagnetic Compatibility (EMC)- Part 6: Generic standards- Section 2: Immunity for industrial environments</p> <p>Specification for Uninterruptible Power Systems (UPS). Part 2: EMC requirements</p> <p>Information technology equipment – Immunity Characteristics – Limits and methods of measurement.</p> <p>Electromagnetic Compatibility – Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use. Part 1: Emission</p> <p>Electromagnetic Compatibility – Product family standard for audio, video, audio-visual and entertainment lighting control professional use. Part 2: Immunity</p> <p><i>Pete. May</i></p> <p>Page 4 of 9</p>	<p>EN 61326 1998</p> <p>EN 61547 1996</p> <p>EN 50130-4 1996</p> <p>EN 55104 1995</p> <p>EN 50083-2 1995</p> <p>EN 60601-1-2 1993</p> <p>IEC 1800-3 1995</p> <p>EN 60555 Part 2 1987</p> <p>EN 60555 Part 3 1987</p> <p>EN 61000-3-2 1995 AS/NZS 61000.3.2 1998 EN 61000-3-3 1995 AS/NZS 61000.3.3 1999</p> <p>ETS 300 386-1 1994</p> <p>ETS EN 300 386-2 1997, 1998</p> <p>ETS 300 132-1 1996</p> <p>ETS 300 132-2 1996</p> <p>ETR 283 1997</p> <p>Electrical equipment for measurement, control and laboratory use – EMC requirements</p> <p>Equipment for general lighting purposes – EMC immunity requirements</p> <p>Alarm Systems. Part 4: Electromagnetic compatibility. Product family standard: Immunity requirements for components of fire, intruder and social alarm systems.</p> <p>Electromagnetic compatibility immunity – requirements for household appliances, tools and similar apparatus. Product family standard.</p> <p>Cabled distribution systems for television and sound signals. Part 2: Electromagnetic compatibility for equipment.</p> <p>Medical electrical equipment Part 1: general requirements for safety Section 2: Collateral standard: Electromagnetic compatibility – requirements and tests</p> <p>Adjustable speed electrical power drive systems. Part 3: EMC product standard including specific test methods.</p> <p>Disturbances in supply systems caused by household appliances and similar electrical equipment. Part 2: Harmonics</p> <p>Disturbances in supply systems caused by household appliances and similar electrical equipment. Part 3: Voltage fluctuations.</p> <p>Electromagnetic compatibility (EMC). Part 3: Limits</p> <p>Section 2: Limits for harmonic current emissions</p> <p>Electromagnetic compatibility (EMC). Part 3: Limits</p> <p>Section 2: Limitation of voltage fluctuations and flicker in low-voltage supply systems.</p> <p>Equipment Engineering (EE); Public telecommunication network equipment electromagnetic compatibility (EMC) requirements Part 1: Product family overview, compliance criteria and test levels</p> <p>Electromagnetic compatibility and radio spectrum matters (ERM); Telecommunication network equipment; Electromagnetic compatibility (EMC) requirements; Part 2: Product family standard.</p> <p>Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac) derived from direct current (dc) sources</p> <p>Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)</p> <p>Equipment Engineering (EE); Transient voltages at Interface A on telecommunications direct current (DC) power distributions.</p> <p><i>Pete. May</i></p> <p>(A2LA Cert. No. 1627-01) Revised 02/21/02</p> <p>Page 5 of 9</p>
<p><i>EU radio standards</i> (ETS) EN 300 385 v1.2.1 1998</p> <p>(ETS) EN 300 220-1 v1.2.1 1997</p> <p>(ETS) EN 300 220-2 v1.2.1 1997</p> <p>(ETS) EN 300 330 v1.2.1 1998</p> <p>ETS 300 328 1996</p> <p>ETS EN 300 440 v1.2.1 1999</p> <p><i>Canada Radio Standards</i> Canadian GL-36 1995</p> <p>Canadian RSS-119 1996</p> <p>Canadian RSS-134 1996</p> <p>Canadian RSS-210 Issue 3, Feb 5, 2000</p> <p>RFS29 1998</p> <p><i>FCC Standards</i> 47 CFR FCC low power transmitters operating on frequencies below 1 GHz, emergency alert systems, unintentional radiators and ISM devices.</p> <p>47 CFR FCC low power transmitters operating on frequencies above 1 GHz, with the exception of spread spectrum devices.</p> <p>(A2LA Cert. No. 1627-01) Revised 02/21/02</p>	<p>Electromagnetic compatibility and Radio spectrum matters (ERM); ElectroMagnetic Compatibility (EMC) standard for fixed radio links and ancillary equipment</p> <p>Electromagnetic compatibility and Radio spectrum matters (ERM); Short range devices; Technical characteristics and test methods for radio equipment to be used in the 25 MHz to 1000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Parameters intended for regulatory purposes</p> <p>Electromagnetic compatibility and Radio spectrum matters (ERM); Short range devices; Technical characteristics and test methods for radio equipment to be used in the 25 MHz to 1000 MHz frequency range with power levels ranging up to 500 mW; Part 2: Supplementary parameters not intended for regulatory purposes</p> <p>Electromagnetic compatibility and Radio spectrum matters (ERM); Short range devices (SRD); Technical characteristics and test methods for radio equipment in the range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz</p> <p>Radio Equipment and Systems (RES); Wideband transmission systems; Technical characteristics and test conditions for data transmission equipment operating in the 2.4 GHz ISM band and using spread spectrum modulation techniques</p> <p>Electromagnetic compatibility and Radio spectrum matters (ERM); Short range devices; Technical characteristics and test methods for radio equipment to be used in the 1 GHz to 40 GHz frequency range</p> <p>Industry Canada – technical requirements for low power Devices in the 2400 – 2483.5 MHz band.</p> <p>Industry Canada – Land mobile and fixed radio transmitters and receivers, 27.41 to 960.0 MHz</p> <p>Industry Canada – 900 MHz narrowband personal communications services</p> <p>Industry Canada – Low power license-exempt radio communication devices</p> <p>Specification for Restricted Radiation Radio Apparatus (New Zealand)</p> <p>Scope A1</p> <p>Scope A2</p> <p><i>Pete. May</i></p> <p>Page 6 of 9</p>	<p>47 CFR FCC Unlicensed Personal Communications System (PCS) devices</p> <p>47 CFR FCC Unlicensed National Information Infrastructure devices and low power transmitters using spread spectrum techniques.</p> <p>47 CFR FCC Personal mobile Radio Services in the following FCC Rule Parts 22, 24, 25, 27.</p> <p>47 CFR FCC General Mobile Radio Services in the following FCC Rule Parts 22, 74, 90, 95, 97.</p> <p>47 CFR FCC Maritime and Aviation Radio Services in 47 CFR Parts 80 and 87</p> <p>47 CFR FCC Microwave Radio Services in 47 CFR Parts 21, 74 and 101.</p> <p>FCC/OST MP-5 1986</p> <p>GR-1089-CORE 1997, 1999</p> <p><i>ANSI EMC Standards</i> ANSI C63.4 1992, 1999</p> <p>ANSI C63.5 1988</p> <p><i>IEEE EMC Standards</i> IEEE C62.41 1980</p> <p><i>Swedish EMC Standards</i> BAKOM 3336.3 1995</p> <p><i>South African EMC standards other than CISPR equivalents</i> SABS 1718-1: 1996</p> <p><i>Japanese VCCI Standards</i> VCCI V-3/99.05 1999 VCCI V-4/99.05 1999</p> <p>Scope A3</p> <p>Scope A4</p> <p>Scope B1</p> <p>Scope B2</p> <p>Scope B3</p> <p>Scope B4</p> <p>FCC (Federal Communications Commission) methods of measurement of radio noise emissions from industrial, scientific and medical equipment.</p> <p>Bellcore electromagnetic compatibility and electrical safety – Generic criteria for network telecommunications equipment.</p> <p>American National Standard for methods of measurement of radio-noise emissions for low-voltage electrical and electronic equipment in the range of 9 kHz to 40GHz.</p> <p>American National Standard for electromagnetic compatibility – radiated emissions measurements in electromagnetic interference (EMI) control – calibration of antennas.</p> <p>IEEE recommended practice on surge voltages in low-voltage AC power circuits</p> <p>Electromagnetic compatibility and electrical safety (EMC &amp; S) for wired terminal equipment. Harmonization documentation information over the OFCOM requirements.</p> <p>South African Bureau of Standards: Specification for Gaming equipment. Part 1: Casino equipment.</p> <p>Technical Requirements</p> <p>Instruction for Test Conditions for Requirement under test</p> <p><i>Pete. May</i></p> <p>(A2LA Cert. No. 1627-01) Revised 02/21/02</p> <p>Page 7 of 9</p>



**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; Protocol analysis and Jitter testing.

Telecom Standards	Title		
FCC 47 CFR Part 68 Telephone Terminal Equipment	Connection of terminal equipment to the telephone network. Analog and Digital Equipment. TCB Scope C1.	TBR 013 : 1996	Business Telecommunications (BTC); 2 048 kbit/s digital structured leased lines (D2048S); Attachment requirements for terminal equipment interface
CS-03 Issue 8 1996 through amendment 3	Specification for terminal equipment, terminal systems, Network protection devices, connection arrangements and hearing aids compatibility. Bulletin Part 68 Rationale and Measurement Guidelines (Feb 1998)	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
TIA/EIA TSB31-B 1998		TBR 24 : 1997	Business Telecommunications (BTC); 34 Mbit/s digital unstructured and structured leased lines (D34U and D34S); Attachment requirements for terminal equipment interface
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 signalling rate up to, and including, 1 984 kbit/s	Australia TS 002 : 1997	Analogue Interworking and Non interference Requirements for Customer Equipment Connected to the Public Switched Telephone Network
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 signalling rates up to 1 920 kbit/s utilizing interfaces derived from CCITT Recommendations X.21 and X.21 bis	TS 016 : 1997	General Requirements for Customer Equipment Connected to Hierarchical Digital Interfaces
TBR 3 : 1995 + Amdt : 1997	Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN basic access	TS 031 : 1997 TS 038 : 1997	Requirements for ISDN Basic Access Interface Requirements for ISDN Primary Rate Access Interface
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	AS/ACIF S043.2:2001	Requirements for Customer Equipment for connection to a metallic loop interface of a Telecommunications Network – Part 2 Broadband
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		
(A2LA Cert. No. 1627-01) Revised 02/21/02			Page 8 of 9

**Product Safety**

General test methods; Input tests; Electric strength tests; Impulse tests; Permanency of marking tests; Accessibility tests; Energy Hazard measurements; Capacitor discharge tests; Humidity conditioning; Earthing tests; Limited power source measurements; Stability tests; Steel ball tests; Lithium Battery Reverse Current measurements; Leakage current tests; Transformer abnormal tests; Telecom leakage tests; Overvoltage/power cross tests.

Product Safety Standards	Title		
<b>Specific Product Safety Standards</b> IEC 950 1991 Includes Amendments 1, 2, 3 and 4 UL 1950 1998	Safety of information technology equipment including electrical business equipment. Safety of information technology equipment, including electrical business equipment.	UL 3111-1 1996 UL 3121-1 1995 IEC 60601-1 1995	Electrical measuring and test equipment. Part 1: General requirements. Medical electrical equipment. Part 1: General requirements for safety.
CSA C22.2 No.950-95	Safety of Information Technology Equipment (UL 1950)	EN 60601-1 UL 2601-1 1997	Medical electrical equipment Medical electrical equipment. Part 1: General Requirements for safety.
UL 60950 2000 IEC 60950 2000 EN 60950 1997, 1998 IEC 60950-1 2001 AS/NZS 3260 1993	Safety of information technology equipment Safety of information technology equipment Safety of information technology equipment, including Electrical business equipment. Approval and test specification – Safety of information technology equipment including electrical business Equipment.	IEC 60065 1998, 2000 ANSI/UL 6500: 1998 CAN/CSA 60065-00	Audio, video and similar electronic apparatus – Safety requirements Audio/video and musical instrument apparatus for Household, commercial and similar general use
AS/NZS 3260 Supp 1 1996	Approval and test specification – Safety of information technology equipment including electrical business equipment – Alphabetical reference index to IEC 950 (Supplement to AS/NZS 3260:1993)	AS/NZS 3250 1995 AS/NZS 60065 2000	Australian/New Zealand Standard – Approval and test Specification – Mains operated electronic and related Equipment for household and similar general use
ACA TS 001 1997	Australian Communications Authority – Safety requirements for customer equipment.	Canadian C22.2 No. 1-94 (1-98) 1994, 1998 EN 60065 1994	Audio, video and similar electronic equipment. Consumer and commercial products Safety requirements for main operated electronic and related apparatus for household and similar general use.
UL 1459 1995 IEC 1010-1 1990 IEC 61010-1 1993	Telephone Equipment Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements.	IEC 60825 1990	Radiation safety of laser products, equipment Classification, requirements and user's guide
EN 61010-1 1993 IEC 61010-1 2000	Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements.	EN 60825-1 1994 IEC 60825-1 2001 IEC 60825-2 2000-5	Safety of laser products Part 1: equipment Classification, requirements and user's guide. Safety of laser products – Part 2: Safety of optical communication systems
UL 3101-1 1993 CAN/CSA 1010-1 1999 (Including AM 2)	Electrical equipment for laboratory use Part 1: General requirements.	IEC 60825-4 1997-11 IEC 60335-1 1995 (Including AM2 – 1997 & AM 12 – 1997) EN 60335-1 2001 UL 60335-1 1998 CAN/CSA E335-1 1994	Safety of laser products – Part 4: Laser guards Safety of household and similar electrical appliances Part 1: General requirements
(A2LA Cert. No. 1627-01) Revised 02/21/02			Page 9 of 9