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PCTC
Product Compliance Test Center
2476 Swedesford Road, Malvern, PA 19355

ELECTROMAGNETIC INTERFERENCE TEST REPORT

Doc. 20040115R / Project No. 968

TEST STANDARD - USA CFR 47 PART 15

STRATA OX WITH TR4025 CONTROL MODULE
ELECTRONIC ARTICLE SURVEILANCE DETECTION SYSTEM
FCC ID: DO4STRATA OX

CHECKPOINT SYSTEMS, INC.
THOROFARE, NJ

Test Date: 4 August to 4 December 2003
Issue: 27 January 2004

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ACCREDITED
AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
Cert. No.: 1028-01

PREFACE

This report documents product testing conducted to verify compliance of the specified EUT with applicable standards and requirements as identified herein. EUT, test instrument configurations, test procedures and recorded data are generally described or attached in the appendices of this report. The reader is referred to the applicable test standards for detailed procedures. The following table summarizes the test results obtained during this evaluation.

SUMMARY

The Checkpoint Systems, Inc., Strata OX with TR4025 Control Module as described in Section 2.1, was tested to the standards listed below, and found to have the following characteristics:

TEST	STANDARD	Frequency Range	RESULT
Radiated Emissions Intentional Radiator, Fundamental	FCC Part 15.223	1.705 to 10 MHz	Below Max. Permissible Limit
Radiated Emissions Intentional Radiator, Harmonics	FCC Part 15.209	10 MHz to 1 GHz	Below Max. Permissible Limit
Radiated Emissions Unintentional Radiator (Related to Digital Circuitry)	FCC Part 15.109	30 MHz to 1 GHz	Below Max. Permissible Limit
Conducted Emissions Unintentional & Intentional Radiators	FCC Part 15.209	450 kHz to 30 MHz	Below Max. Permissible Limit

MEASUREMENT UNCERTAINTY				
Measurement Type	Measurement Dist	Frequency Range	Measurement Limit	Expanded Combined Uncertainty
Radio Disturbance	10 meters	30 MHz to 1 GHz	Class A	4.3 dB
Radio Disturbance	10 meters	30 MHz to 1 GHz	Class B	5.0 dB
Radio Disturbance	3 meters	30 MHz to 1 GHz	Class B	4.3 dB
Conducted Disturbance	N/A	150 kHz to 30 MHz	Class A or B	3.6 dB

As all values of uncertainty are less than the CISPR/A/355/FDIS (CISPR 16-4/FDIS) recommendations, no adjustments to measured data presented in this report are required.

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1.0 Client Information

Client Name:	Checkpoint Systems, Inc. 101 Wolf Drive Thorofare, NJ 08086
Coordinator(s):	Gregory Sleet
PCTC Test Personnel:	Paul Banker Daniel Mis Itamar Gonen

1.1 Requested Service

- Measurement of radio disturbance characteristic of sample product to FCC Part 15.223 (Intentional Radiators) and FCC parts 15.207 and 15.209 (Unintentional Radiators).

1.2 Purpose of Test(s)

The purpose of testing was to verify compliance of the sample EUT to regulatory and/or qualification requirements adhered to by the client for product sale, distribution and use.

2.0 Description of The Equipment Under Test (EUT)

2.1 Equipment Family Description

2.1.1 General

The Strata OX System is a transceiver design using remote electronics connected to two open-loop antennas that protect a six-foot-wide area. The Strata OX System is a transceiver design using remote electronics connected to a canceling two loop and three loop antenna that protect a six-foot-wide area. Antennas may be installed side-by-side to cover larger openings. The TR4025 alternates between its two antennas (designated "Loop 1," and "Loop 2"). This technique provides the system with different views of the detection field allowing the system to improve detection by minimizing the holes that would otherwise be found near the edges of the antennas. During an antenna's cycle, the system performs two "blasts" which are called a "bin". There are sixteen bins per frame. A bin consists of two "noise" cycles and two receive cycles, a blast is a transmit cycle and then a receive cycle. During the noise cycle, the system is not transmitting, but only receiving ambient noise. This allows the system to establish the baseline noise level of the environment for later comparison. The system then transmits or "pulses" the field and then receives or "listens" for an echo of a tag signal. The pulse-listen sequence is performed for each of the 16 bins while receiving on each antenna. The transmitter switches between the Loop 1 and Loop 2 antennas on alternate blasts. A tag response need only be present on one of the antennas to cause an alarm. The switching of the transmitter between antenna loops minimizes the size of detection holes at the null points of the RF field.

The TR4025 electronics PCB consists of two class-D HF transmitters, synchronous I and Q receiver, RF selector switch, DDS, and a DSP-based computer used to detect the presence of the target. All control and subsystem interface signals are generated and controlled by an FPGA.

The power supply is a linear type 24VDC 4.0 Amp design.

DIRECT DIGITAL SYNTHESIZER (DDS) OPERATION

The Direct Digital Synthesizer (DDS) generates a sequence of 16 discrete frequencies from 8.6 MHz to 7.6 MHz (digital sweep). The FPGA loads the DDS with the desired frequency for transmission. The DSP initializes the FPGA on power-up.

The source of the digital sweep is controlled by SW6. Normal operation is in Master Mode, (SW6-1 is ON) in which the sweep is generated on-board, with SW7 controlling its center frequency and width. The on-board sweep is also made available for distribution to adjacent TR4025s operating in slave mode (they are configured with SW6-1 OFF).

TRANSMITTER OPERATION

The two transmitters are functionally identical, one is used to drive the "Loop 1" antenna and the other to drive "Loop 2." Each TX is functioning in a push-pull, class-D mode of operation. The control signals are timed for 64 12-microsecond bursts at approximately a 100 Hz rate. The signals are grouped into 16 pairs of frequencies. The frequencies used are dictated by the digital sweep, controlled by the FPGA. Each bin is transmitted two times for 12 mS each; each transmission on a bin is known as a "blast." A sweep of all of the bins is performed while receiving on each loop, with the transmitters alternating on each blast. The sequence is as follows: transmit on "Loop 1," receive on "Loop 1;" transmit on "Loop 2," receive on "Loop 1;" transmit on "Loop 1," receive on "Loop 2;" transmit on "Loop 2," receive on "Loop 2." This pattern constitutes the "frame" of the Strata OX System.

The overall duty cycle for transmitter operation is **7.68 percen**t. This rate is derived by taking the amount of time that the transmitter is operational (2 antennas * 16 bins * 2 blasts per bin * 12 microseconds per blast = 768 microseconds) and dividing it by the frame rate of 100 Hz (10 milliseconds).

The FPGA receives its exact frequency timing from the DDS section. The function of the FPGA is to gate the control signals with the specific timing required by the system. The control signals from the FPGA drive a MOSFET driver U33 for the "Loop 1" output and U32 for "Loop 2." The MOSFET drivers U32 and U33 drive the gates of a pair of N-channel power MOSFETs (Q7, Q8, Q9, Q10). The sources of the MOSFETs are grounded and the drains are connected to opposite sides of the primary of an isolation transformer whose center tap is connected to the transmitter V_{DD} supply line. The V_{DD} supply is controlled using an NPN bipolar transistor whose base voltage may be varied using an adjustable potentiometer. This potentiometer is used to control the overall transmitter power and is pre-set at the factory for a specific level.

The output transistors are coupled to the isolation transformer through diodes D23, D24, D18 and D25. This method prevents the transmitter output power stage from loading the receiver input and therefore improves the receiver's sensitivity to the signal from the target.

The secondary of the isolation transformer is unbalanced and is connected to a low-pass filter with a cutoff of 12 MHz. The filter connects to the primary of another isolation transformer. This second transformer serves two functions: one is to match the impedance of the transmission line to that of the filter, the second is to provide common-mode isolation.

2.2 Equipment Sample

2.2.1 Identification

A production model of the Strata OX with TR4025 Control Module was tested:

Description:	Electronic Article Surveillance System (Anti-Pilferage Device)
Model:	Strata OX with TR4025 Control Module
Serial Number	Strata OX: 7427688C0C2012803011 TR4024 Controller: 15033300P02010200007 Worldwide 224 Power Supply: TJ2627
Manufacturer:	Checkpoint Systems, Inc.
Received by PCTC:	4 August 2003
Sample type	Production

Photos of the Strata OX with TR4025 Control Module can be found below.

Photo 1 – Image of TR4025 Control Module and Antenna Element of Strata OX

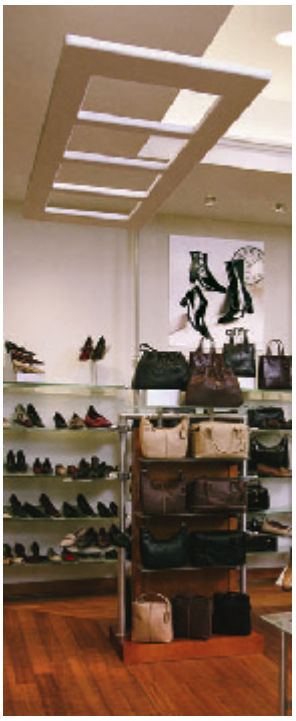


Photo 2 – Liberty OX

Physical Specifications for the Strata OX

- ***Dimensions:***
  - ***Height:*** *67" (170.2 cm)*
  - ***Width:*** *21.5" (54.6 cm)*
  - ***Depth:*** *1.0" (2.54 cm)*
- ***Material:***
  - ***Antenna Frame:*** *High Impact ABS Plastic*
- ***Color:*** *Off White*

2.2.2 Condition of Received Sample

An evaluation of the Checkpoint, Strata OX with TR4025 Control Module was conducted to verify test subject identity and condition and to ensure suitability for testing. No evidence of physical damages was noticed. The test item condition was deemed acceptable for the performance of the requested test services.

3.0 Applicable Requirements, Methods And Procedures

3.1 Applicable Requirements

The results of the measurement of the radio disturbance, fundamental and bandwidth, characteristics of the EUT described herein may be applied, and where appropriate provide a presumption of compliance to one or more of the following regulatory requirements or to other requirements at the discretion of the client, regulatory agencies, or other entities.

3.1.1 USA

- FCC 47 CFR, Part 15, Subpart B, "Unintentional Radiators"
- FCC 47 CFR, Part 15, Subpart C, "Intentional Radiators"

3.2 Basic Test Methods and Procedures

The applicable regulatory product family or generic standards require that radio disturbance/ interference tests be performed in accordance with the following:

- ANSI C63.4, 2001 " Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in The Range of 9 kHz to 40 GHz".

Detailed descriptions of the test procedures are provided in Appendix 2 of this report.

4.0 Deviations or Exclusions from the Requirements and Standards

Per customer instructions and agreement with FCC, for measurement of the fundamental and harmonic emissions in the band 1.705 MHz to 10 MHz, a 20 dB reduction from the true peak is to be compared to the limits of 100 µV/meter (40 dBµV/meter) at 30 meters. The EUT is to be modulated as normally installed. True peak is the point at which the analyzer bandwidth is adjusted for minimum pulse desensitization. A copy of the correspondence between Checkpoint and FCC is attached in Appendix 4 for reference.

Measurement of the fundamental -- 7.6 to 8.8 MHz -- was performed by setting a spectrum analyzer to "max-hold", peak detector, a 300 kHz bandwidth, and a span from 6.5 to 10.5 MHz. A resolution bandwidth of 300 kHz was used in performing the "true peak" measurements, because increasing the bandwidth above 300 kHz did not increase the detected peak of the fundamental.

5.0 Operation of the EUT during Testing

5.1 Test Environment

5.1.1 Climatic Environment

The following were the ambient conditions in the laboratory during testing:

Temperature:	22^{o} C $\pm$ 1^{o} C
Relative Humidity	50% RH $\pm$ 10%

5.1.2 Electrical Power

The EUT was operated at electrical power voltages sufficient to ensure that the measured results were representative of operation of the EUT in the power environments in which it would be installed, as specified by the client. Specifically, the EUT was supplied AC power at 120 Vac/60 Hz for all testing described in this report.

5.2 Grounding

AC ground was provided to the power supply via the AC power cord.

5.3 Operating Mode

During testing, the STRATA OX was continuously transmitting and monitoring for the presence of a security tag. By design, the EUT is not capable of "standby mode". A security tag was swept through the field of the STRATA OX antenna every 5 seconds to initiate a verification cycle. During this cycle, the STRATA OX would indicate the presence of an article tag with an audible alarm. A green LED on the logic module of the unit would light if the tag was detected and red or yellow LED would light if an error occurred.

5.3.1 Operation in Restricted Bands

The TR4025 is a digital swept frequency hopping transmitter. The TR4025 hops on discrete frequencies. The discrete frequencies that can be transmitted by the TR4025 in the 8.2 MHz operational band are as follows:

7.600708 MHz	7.673950 MHz	7.747192 MHz	7.820435 MHz
7.893677 MHz	7.966919 MHz	8.040161 MHz	8.113403 MHz
8.186646 MHz	8.259888 MHz	8.333130 MHz	8.406372 MHz
8.479614 MHz	8.552856 MHz	8.626099 MHz	8.699341 MHz

The restricted frequency bands (per FCC Part 15 Clause 15.205) in the operating frequency band of the EUT are as follows:

8.291 - 8.294MHz
8.362 – 8.366 MHz
8.37625 – 8.38675 MHz
8.41425 – 8.41475 MHz

The transmitter is not capable of hopping into, or operating in, the restricted frequency bands and therefore, complies with the restriction.

5.4 Test Configurations

All testing described in this report was performed with the EUT in the equipment configuration shown below. The drawing shows the block diagram of the tested configuration used for the EMI and immunity tests along with AC power distribution. There were no external interfaces or support equipment attached to the Strata OX with TR4025 Control Module.

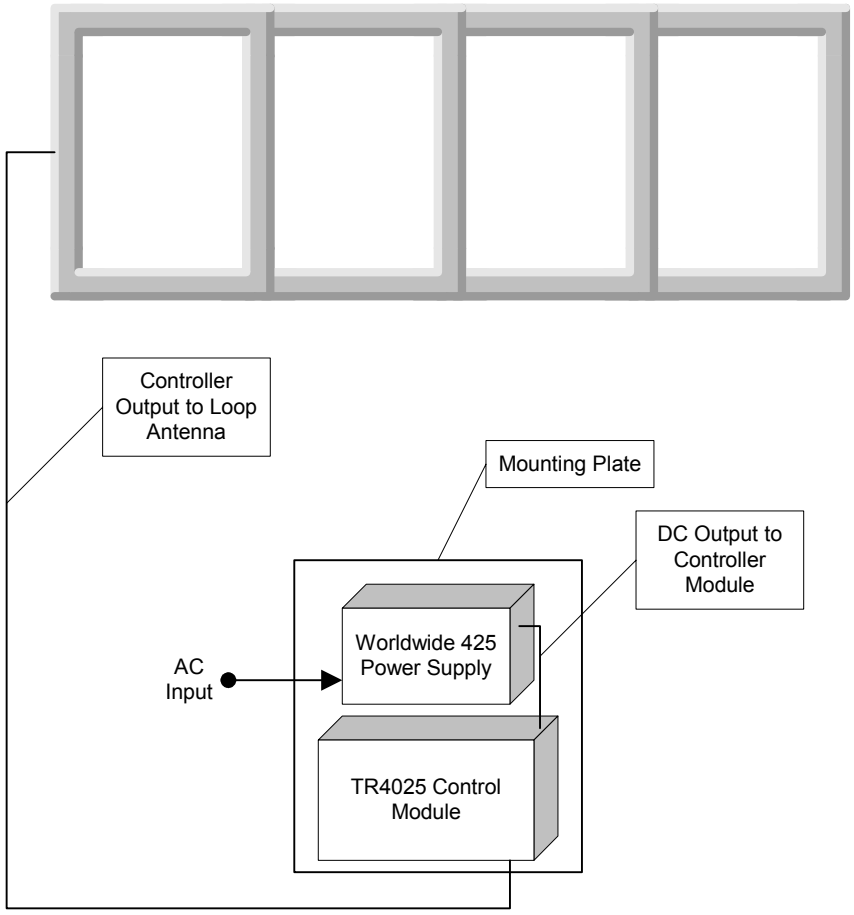


Figure 1 – Block Diagram, EMI Testing of Strata OX with TR4025 Control Module

CABLE LIST

1. DC Power Cable, 6 inches, shielded
2. AC Line Cord, 7', Eupen #IMX-04, shielded
3. Antenna Cable, 25 feet, unshielded

5.4.1 EUT Details

The following devices were installed in the test field during testing:

Description	Model #	Part #	Manufacturer	Serial #
Antenna Structure	Strata OX with TR4025 Control Module	7427688	Checkpoint Systems, Inc.	7427688C0C2012803011
Power Supply	Worldwide 224		Checkpoint Systems, Inc.	TJ2627
Control Module	TR4025	150333	Checkpoint Systems, Inc.	1503330P02010200007

5.4.1 Support Equipment

No equipment was used to support the operation of the Strata OX with TR4025 Control Module during testing. This is a standalone product.

5.5 EUT Modifications

No modifications were required for compliance of the EUT.

6.0 Summary Of Test Results

6.1 Emission Tests

6.1.1 Radiated Emission Test (22 September 2003)

Tables 1, through 5 below show the detected field strengths as measured from the EUT(s) over the frequency range from 7.4 MHz to 30 MHz, at a distance of 30 meters compared to the maximum permissible FCC limit at 30 meters. All measurements were made with the magnetic field loop measuring antenna supported 1-meter above the ground plane. A description of the procedures used in the performance of this test is provided in Appendix 2.

- **MEASUREMENT OF THE FUNDAMENTAL**

Table 1 shows the true peak measurement of the fundamental and the comparison of the adjusted true peak to the average limit, performed in accordance with the procedure outlined by FCC instruction.

Table 1 – 8.2 MHz Fundamental Measurement – True Peak (22 September 2003)

Freq [MHz]	Height, Pol (1) [cm 1/2/3]	Angle [Deg]	True Peak Field Strength [dBuV/m] (2)	Corr' Factor [dB/m] (3)	Field Strength [dBuV/m]	FCC Average Limit @ 30m [dBuV/m]	Delta Limit [dB]
8.2 Fund*	100, 1	360	59.9 Peak	-20.0	39.0	40	-0.1
8.2 Fund*	100, 2	360	48.2 Peak	-20.0	28.2	40	-11.8
8.2 Fund*	100, 3	0	49.4 Peak	-20.0	29.4	40	-10.6

*The true peak signal level of the fundamental was measured using a peak detector as described in section 4.0. Measurement of the fundamental was performed using a broadband magnetic field loop antenna. The loop antenna was located on the ground plane at a distance of 30 meters from the EUT.

1) Polarity of the measuring loop antenna is 1 - along measuring axis, 2 - along vertical axis, 3 horizontal axis.

2) Peak Detector Voltage shown includes an E-Field antenna correction factor of 16.6 dB/m.

3) The correction factor shown represents the 20 dB reduction as specified in the measurement procedure.

- **MEASUREMENT RESULT -- AVERAGE**

As indicated earlier, the 8.2 MHz transmitter operates with a duty cycle of 7.68%. This would result in the following calculations for conversion from peak to average and a subsequent comparison of the fundamental with the average limit. (Guidance for this calculation was taken from HP Application Note 150-2 Spectrum Analysis – Pulsed RF).

Table 2 – Calculated Average vs. Average Limit

	8.2 MHz Fundamental
Corrected True Peak:	59.9 dBµV/m
Pulse Duty Cycle:	7.68%
Correction to Average: 20 * Log_{10} (Duty Cycle)	-42.2dB
Average Level: (True Peak + Average Correction)	17.7 dBµV/m
Limit:	40 dBµV/m
Margin with Limit:	-22.3 dB

- **MEASUREMENT OF HARMONICS BELOW 30 MHz**

Tables 2 shows the recorded levels of emissions of the harmonics found below 30 MHz specifically, signals outside the frequency range of 1.705 MHz to 10 MHz, using a quasi-peak detector, for harmonics recorded of the 8.2 MHz fundamental.

Table 3 – H-Field Emissions (< 1.705 MHz and > 10 MHz) (22 September 2003)

Freq [MHz]	Height, Pol[1] [cm 1/2/3]	Angle [Deg]	Quasi-Peak Detector Voltage [dBuV]	E-Field Corr' Factor [dB/m]	Q-P Field Strength [dBuV/m]	FCC QP Limit @ 30m [dBuV/m]	Delta Limit [dB]
16.4	100, 1	0	6.9	16.1	23.0	30	-7.0
24.6	100, 1	360	18.8		19.8	30	-10.2

1) Polarity of the measuring loop antenna is 1 - along measuring axis, 2 - along vertical axis, 3 horizontal axis.

NOTE: No emission could be detected at the third harmonic of 24.6 MHz.

- **MEASUREMENT OF INTENTIONAL RADIATOR EMISSIONS – 30 MHz TO 1 GHz**

There were no signals recorded in the frequency range of 30 MHz to 1000 MHz, which were determined to be harmonics of the fundamental carrier frequency.

- **SIGNALS RELATED TO DIGITAL CIRCUITRY– 30 TO 1000 MHz – FCC 15.209**

Table 5 below shows the detected field strengths of signals determined to be related to the operation of the digital circuitry of the controller, as measured from the EUT over the frequency range from 30 MHz to 1000 MHz, using an E-field antenna at a distance of 10 meters compared to the maximum permissible FCC Class A limit. A description of the procedures used in the performance of this test is provided in Appendix 2.

Table 4 – E-Field Emissions Related to Digital Circuitry (22 Sept. 2003)

Freq [MHz]	Pk [dBuV/m]	Q-Pk [dBuV/m]	Pol	Angle [deg]	Ht [cm]	CF [dB]	Limit [dBuV/m]	Delta [dB]
227.177	41.17	34.68	V	52	100	13.75	46	-11.32
239.49	47.96	41.04	V	55	100	14.13	46	-4.96
243.572	49.35	42.34	V	53	100	14.26	46	-3.66
243.572	48.78	41.86	H	87	143	14.26	46	-4.14
245.567	49.13	42.26	V	50	100	14.32	46	-3.74
249.996	50.23	42.8	V	45	100	14.45	46	-3.2
252.191	48.42	41.21	H	91	208	14.57	46	-4.79
252.195	47.62	40.24	V	43	100	14.57	46	-5.76
340.873	42.3	35.06	V	69	100	16.99	46	-10.94
341.632	41.03	33.78	V	70	100	17	46	-12.22
343.838	43.03	35.77	V	68	100	17.06	46	-10.23
466.312	45.56	38.36	V	57	100	20.19	46	-7.64
482.396	47.23	40.04	V	243	100	20.5	46	-5.96

- Overall Result: All measured radiated emissions from the Strata OX with TR4025 Control Module are below the FCC Class A limits by a margin of at least 3.2 dB.

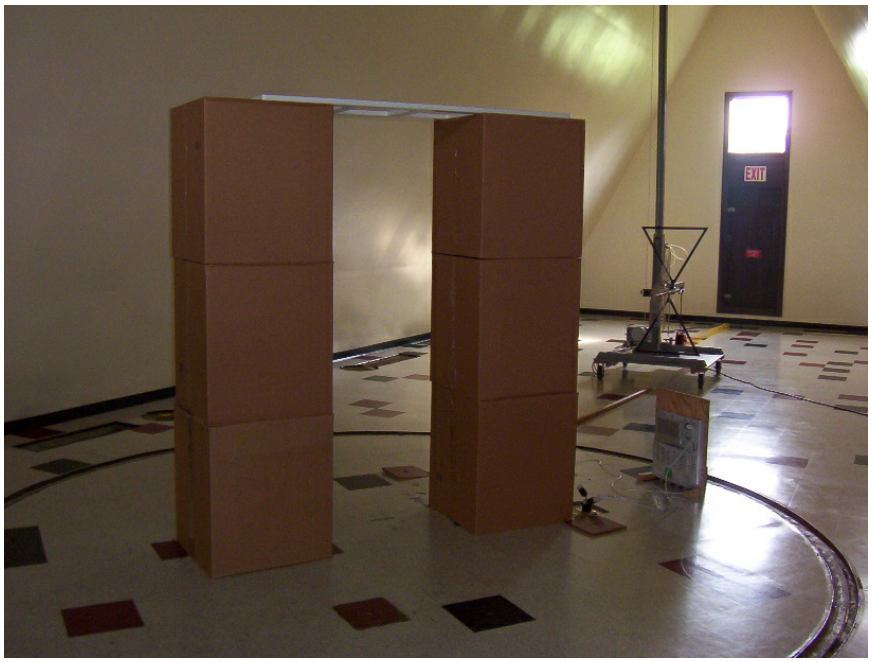


Photo 3 – Photo of EMI Test Setup (Rear View)

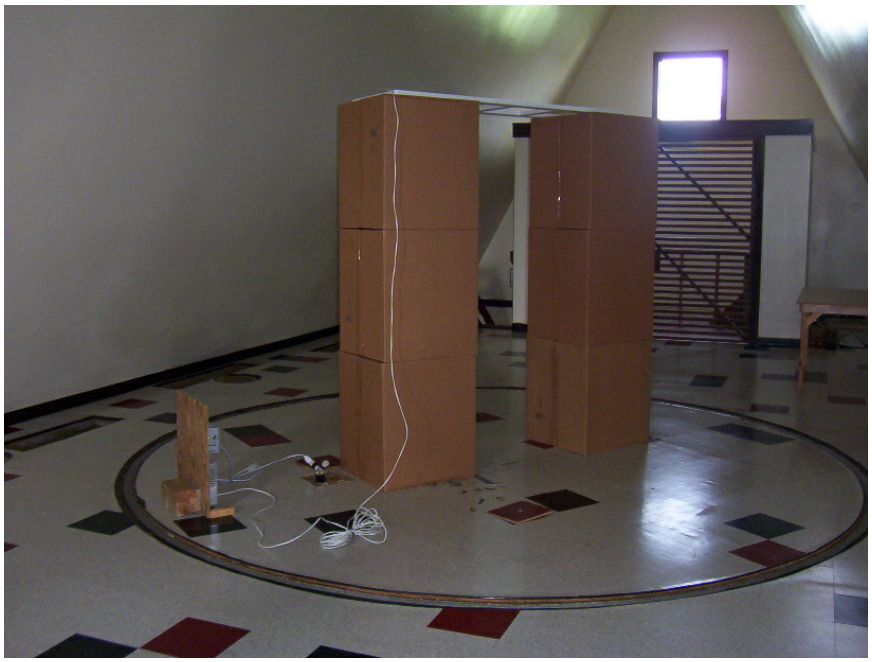


Photo 4 – Photo of EMI Test Setup (Front View)

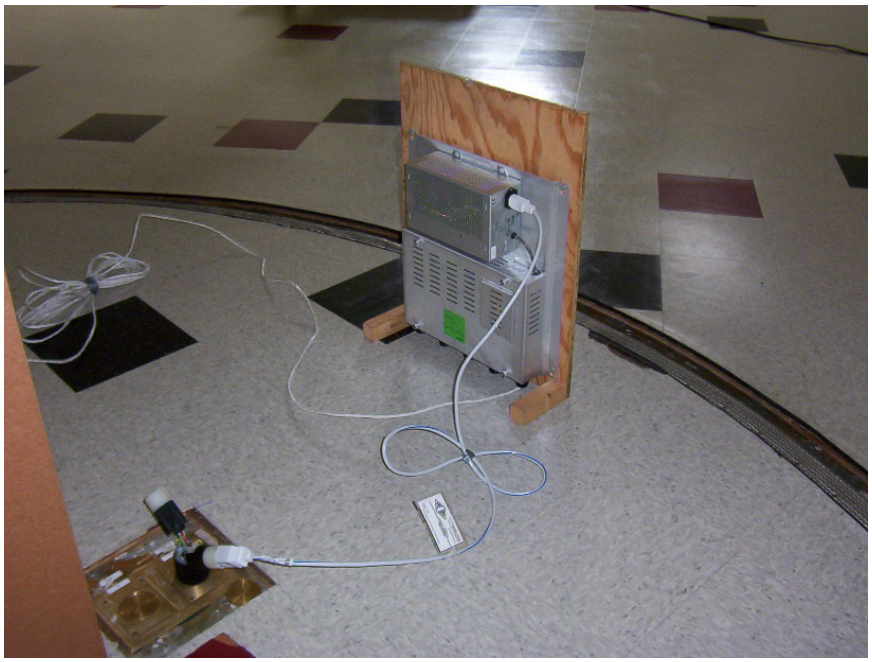


Photo 5 – Detail of Control Module and Cable Layout

6.1.2 Bandwidth Measurement (6 December 2003)

A bandwidth plot of the fundamental operating frequencies – 8.2 MHz – was recorded on the operating Liberty OX by placing the measuring antenna 30 meters from the EUT, setting a spectrum analyzer to 10 dB/div, RBW=300 kHz, VBW=3 kHz, span = 2.0 MHz, Peak detection, max hold. In accordance with Clause 15.223, the plot shows the bandwidth defined by the points 6 dB down from the peak.

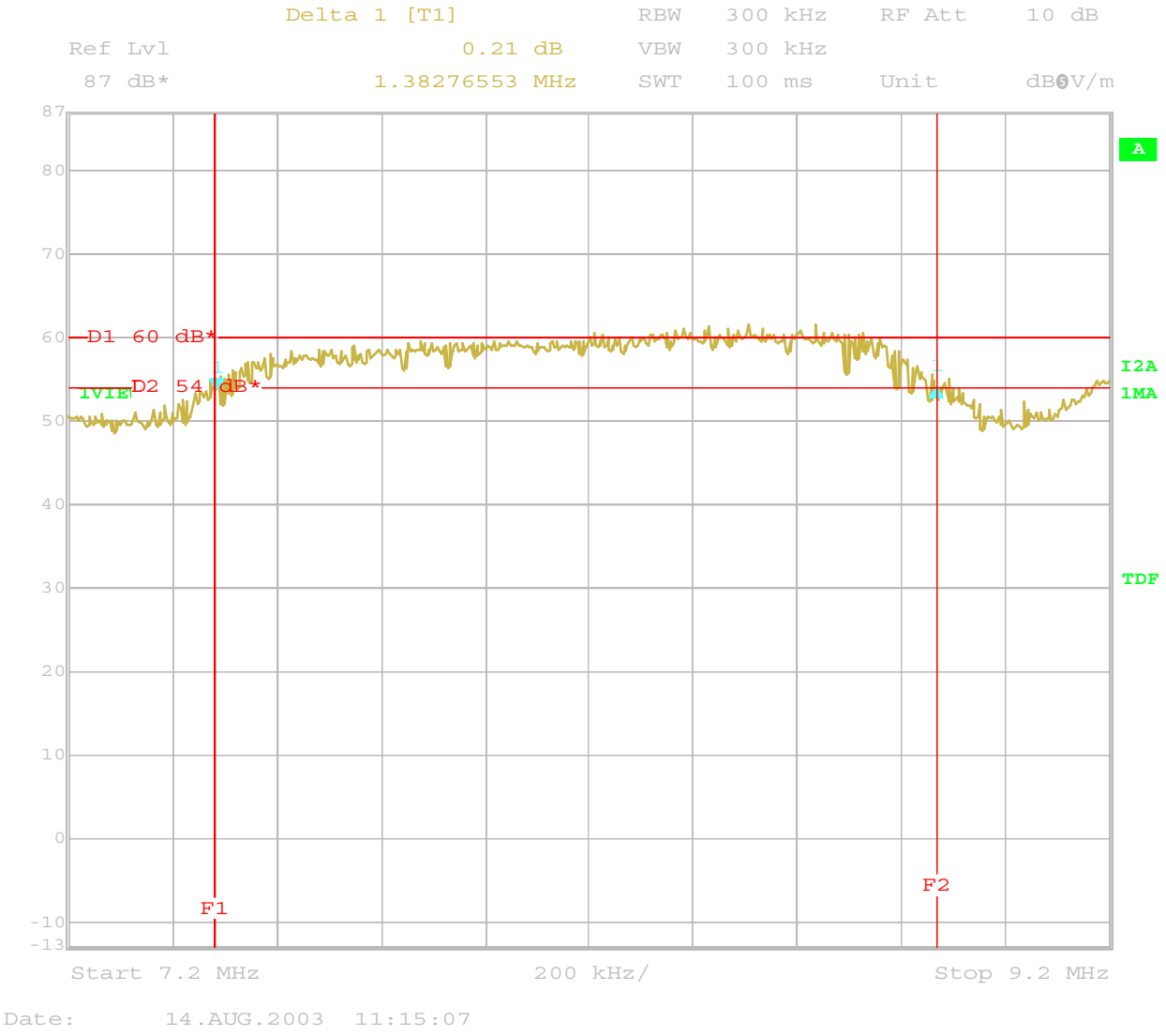


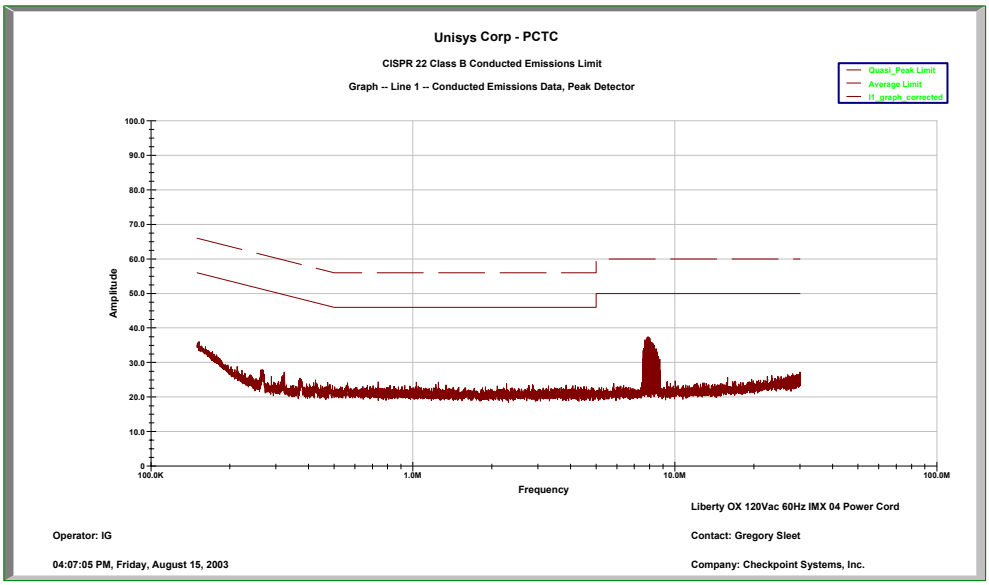
Figure 2 – 8.2 MHz Fundamental 6-dB Bandwidth Plot

The plot above of the 8.2 MHz fundamental, indicates the transmitter 6 dB bandwidth is 1.383 MHz. This bandwidth is 16.9% of the fundamental (1.346 MHz / 8.2 MHz) and therefore, per FCC Section 15.223, the limit of 100 µV/m applies for the 8.2 MHz fundamental.

6.1.3 Conducted Emission Test (15 August 2003)

The following tables show the conducted emissions measurement results over the frequency range 150 kHz to 30 MHz for the EUT for devices operating under FCC 15.223, where the limit of FCC 15.207 applies. A description of the procedures used in the performance of this test is provided in Appendix 2.

- Wordwide 224 Deltron Power Supply, Neutral Line 120VAC/60Hz



Graph 1 – Peak Detector Emissions - Neutral

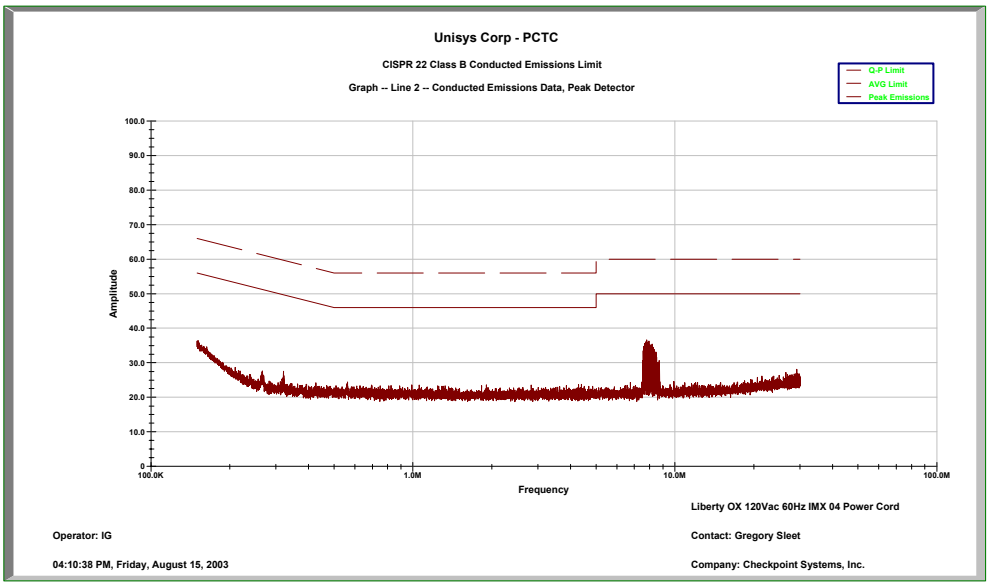
Table 5 – Conducted Emissions, Neutral Line (15 August 2003)

Unisys Corp – PCTC
CISPR 22 Class B Conducted Emissions Limit
Table 1 – Line 1 – Conducted Emissions Data, Peak Detector

Operator: IG
Item Under Test: Liberty OX 120Vac 60Hz IMX 04 Power Cord
Contact: Gregory Sleet
04:07:05 PM, Friday, August 15, 2003
Company: Checkpoint Systems, Inc.

	1	2	3	4	5	
Frequency	Top 10	Peaks	Avg.	Margin with	Corr.	
MHz	Peaks	Within 1	Limit	Avg. Limit	Factor	
7.678 MHz	36.513		50.000	-13.487	10.613	
7.719 MHz	36.517		50.000	-13.483	10.617	
7.793 MHz	37.025		50.000	-12.975	10.625	
7.867 MHz	37.332		50.000	-12.668	10.632	
7.892 MHz	37.135		50.000	-12.865	10.635	
7.940 MHz	37.340		50.000	-12.660	10.640	
7.952 MHz	37.141		50.000	-12.859	10.641	
8.011 MHz	36.947		50.000	-13.053	10.647	
8.029 MHz	36.149		50.000	-13.851	10.649	
8.169 MHz	35.863		50.000	-14.137	10.663	

- Wordwide 224 Deltron Power Supply, Phase Line 120VAC/60Hz



Graph 2 – Peak Detector Emissions - Phase

Table 6 – Conducted Emissions, Phase Line (15 August 2003)

Unisys Corp - PCTC
CISPR 22 Class B Conducted Emissions Limit
Table 1 – Line 2 – Conducted Emissions Data, Peak Detector

Operator: IG
Item Under Test: Liberty OX 120Vac 60Hz IMX 04 Power Cord
Contact: Gregory Sleet
04:10:38 PM, Friday, August 15, 2003
Company: Checkpoint Systems, Inc.

	1	2	3	4	5	
Frequency	Top 10	Peaks	Avg.	Margin with	Corr.	
MHz	Peaks	Within 1	Limit	Avg. Limit	Factor	
7.664 MHz	35.563		50.000	-14.437	10.663	
7.675 MHz	35.164		50.000	-14.836	10.664	
7.734 MHz	35.971		50.000	-14.029	10.671	
7.752 MHz	35.973		50.000	-14.027	10.673	
7.808 MHz	36.579		50.000	-13.421	10.679	
7.819 MHz	35.680		50.000	-14.320	10.680	
7.867 MHz	35.885		50.000	-14.115	10.685	
7.892 MHz	35.988		50.000	-14.012	10.688	
7.955 MHz	36.195		50.000	-13.805	10.695	
8.173 MHz	35.419		50.000	-14.581	10.719	

- Overall Results:

  - The Strata OX with TR4025 Control Module complied with the requirements of FCC 15.207 by a margin of at least 12.6 dB (peak detector vs. the average limit).

Photo 6 – Conducted Test Setup

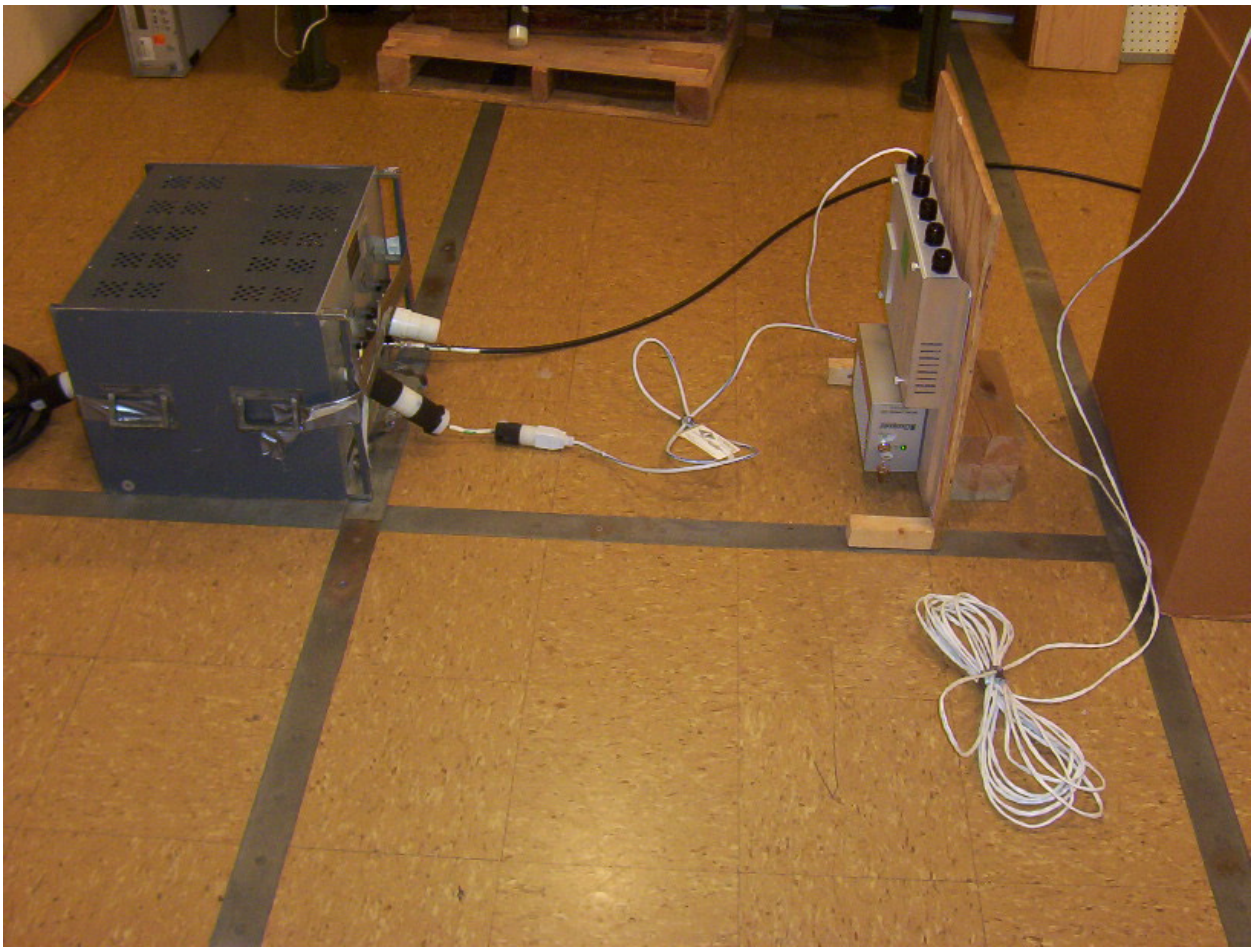


Photo 7 – Close up of LISN

Appendix 1 – Test Equipment Listing

Radio Disturbance Test Equipment

Description	Freq. Range (Hz)	Model Number	Manufacturer	ID / SN	Last Cal Date
Adapter, Quasi Peak	10k - 1G	85650A	Hewlett Packard	U182	10/1/03
Analyzer, Spectrum	100Hz - 1.5G	8568B	Hewlett Packard	U180	6/17/03
Antenna	25M - 2G	LFB-2520	ARA	B962	1/28/03
Computer	NA	9836	Hewlett Packard	V831	NA
Controller, Tower	NA	1050	EMCO	W926	NA
Controller, Turntable	NA	1060	EMCO	W580	NA
Display, Analyzer	NA	85662A	Hewlett Packard	X719	6/17/03
Drive, Floppy (external)	NA	9122	Hewlett Packard	X711	NA
Drive, Hard (external)	NA	7957B	Hewlett Packard	Y0763	NA
Receiver	20 Hz – 26.5 GHz	ESIB 26	Rohde & Schwarz	C232	1/10/03
LISN	9k - 30M	NNLK 8121	Schwarzbeck	X722	2/5/03
Loop Antenna, Active	1 kHz-30 MHz	6507	EMCO	D244	11/26/02

Appendix 2 – Description Of Test Facility and Procedures

A.2.0 Description of Test Methods

A.2.1 Emissions Testing

A.2.1.1 Radiated Emissions Test

Test Facilities

The test site is an all weather, open field measurement facility defined by an elliptical area of 3258 square meters, which is free of reflective metallic objects and extraneous electromagnetic signals. A non-metallic A-Frame enclosure covers 172 square meters of the ellipse. This enclosure contains a ground level 5 meter diameter turntable, capable of rotating equipment through a complete 360 degrees, and a 3 meter and 10 meter test range with remotely controlled antennae masts. The floor of the A-Frame and surface of the turntable are covered with a flat metal continuous ground plane. The ground plane extends outside the A-Frame to a distance of 35.6 meters from the center of the turntable. The width of the extension is 2.4 meters.

The ground plane is partially covered with protective insulating material. A cellar located beneath the ground level of the A-Frame structure houses personnel and instrumentation for remote control of the antennae, the turntable, and other equipment above ground level. The test site complies with the Attenuation Measurements specified in ANSI C63.4 - 1992, and is registered with FCC, and is accredited by AALA, VCCI, and NEMKO.

For electric field radiated emissions, the EUT and support peripherals or devices required to facilitate EUT operation were positioned either directly on the turntable surface or on a wooden table 80 cm. in height, depending on the size of the sample. Hardware not needed in the test field such as remote terminals or non standard exercisers, were placed in the basement below the turntable.

Procedures 9kHz to 30 MHz

Testing below 30 MHz was performed with the EUT configured on the test site as above. An H-field measuring antenna was placed at a distance of 30 meters from the EUT at a height of 1 meter above the ground plane. The EUT was rotated 360° in order to obtain a maximum indication on the measuring receiver. This was repeated for each of the three polarizations of the antenna. In some cases the measuring antenna was taken off the ground plane and placed in the adjacent grass area. The position of the antenna relative to the ground plane was noted in the reported data.

Procedures 1.704 MHz to 10 MHz

Testing below 30 MHz was performed with the EUT configured on the test site as above. An H-field measuring antenna was placed at a distance of 30 meters from the EUT at a height of 1 meter above the ground plane. The EUT was rotated 360° in order to obtain a maximum indication on the measuring receiver. This was repeated for each of the three polarizations of the antenna.

Per the agreement between Checkpoint and FCC, testing in this frequency range for fundamental and harmonic emissions, a 20 dB reduction from the true peak was compared with the average limit of 100 µV/meter (40 dBµV/meter) at a measurement distance of 30 meters. The unit under test shall be modulated as normally installed.

True peak was determined by setting the spectrum analyzer with peak detector, to “max-hold” and a frequency span of a minimum of 1.5 MHz. The resolution bandwidth was increased until no further change was noted in the peak level of the emission. Because of the duty cycle and repetition rate of the pulsed signals, a bandwidth of 300 kHz was found to be sufficient to display the true peak level of the fundamental. This insured that pulse desensitization has been minimized. The peak level was then recorded.

Procedures 30 MHz to 1000 MHz

Initial measurements, for the purpose of identifying suspect emissions from the equipment under test, were performed by dividing the test frequency range into the following twenty bands:

1)	30 - 40 MHz	8)	108 - 148 MHz	15)	570 - 670 MHz
2)	40 - 50 MHz	9)	148 - 165 MHz	16)	670 - 770 MHz
3)	50 - 88 MHz	10)	165 - 200 MHz	17)	770 - 855 MHz
4)	88 - 93 MHz	11)	200 - 300 MHz	18)	855 - 875 MHz
5)	93 - 98 MHz	12)	300 - 450 MHz	19)	875 - 892 MHz
6)	98 - 103 MHz	13)	450 - 470 MHz	20)	892 - 1000 MHz
7)	103 - 108 MHz	14)	470 - 570 MHz		

Each of these bands was monitored on a spectrum analyzer display while the turntable was initially positioned at the reference 0 degree point. A mast mounted broadband antenna was located at a distance of 10 meters from the periphery of the EUT(s). The antenna was set to 1 meter height, for the vertical polarity and 2.5 meters height, for horizontal polarity for these suspect emission scans. All emissions with amplitudes 8 dB or less below the appropriate regulatory limit were identified and saved for later source identification and investigation. This initial suspect identification procedure was repeated for turntable positions of 90, 180 and 270 degrees.

The source of questionable emissions was verified by powering off the EUT(s). Those emissions remaining were removed from the suspect list. Valid suspect emissions were then maximized through cable manipulation. The highest six signals or all within 4 dB of the limit, identified during this initial investigation, were then maximized by rotating the turntable through a complete 360 degrees of azimuth and raising the antenna from 1 to 4 meters of elevation. When the EUT(s) azimuth, antenna height and polarization that produced the maximum indication were found, the emission amplitude and frequency were remeasured to obtain maximum peak and quasi-peak field strength. The frequencies and amplitudes of RFI emissions are recorded in this report in units derived as follows:

Field Strength (dBuV/m) = meter reading (dBuV)
+ antenna factor (dB/m)
+ Cable Loss (dB)

A.2.1.2 Conducted Emissions Test

Procedure 450 kHz To 30 MHz

Peak amplitude terminal voltage emissions at the power line input to the EUT(s) were measured with a spectrum analyzer, using a peak detector and the appropriate CISPR bandwidth, connected to the RF output of a 50 Ohm, 50 microhenry Line Impedance Stabilization Network (LISN) installed in each power line. Measurements were made over the frequency range from 450 kHz to 30 MHz while the EUT(s) was operating as described in paragraph 5.3.

The significant amplitudes of emissions measured on the AC power lines of the EUT(s) are recorded in this report in units derived as follows:

Peak Emission (dBuV) = meter reading (dBuV)
+ LISN factor (dB)

Note: For speed and convenience, a spectrum analyzer employing a peak detector was used as the measuring receiver to sweep through and record the spectrum. As a tool to judge compliance of the emissions, the peak detector sweep is displayed and graphed against the appropriate average limit. This type of measurement is valid given that the peak reading will always be greater than or equal to the average or quasi-peak reading. Peak emissions recorded with the spectrum analyzer that exceed the average limit, or are found to be within 2 dB of the average limit are re-measured using a manually tuned receiver with the detector function first set to quasi-peak and then to average.

Appendix 3 – EUT Drawings

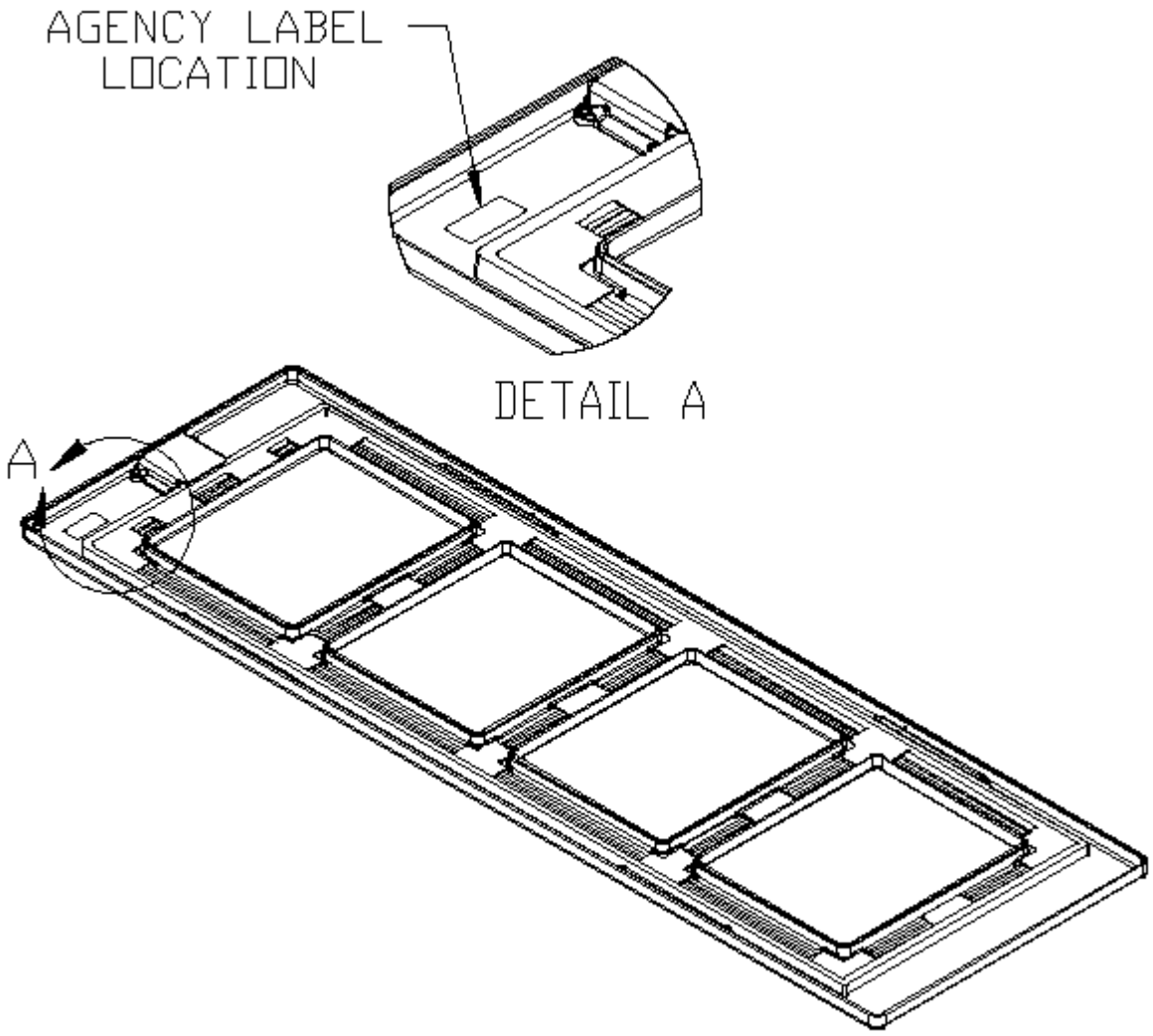


Figure 3 – Location of Agency Labels on the Liberty OX

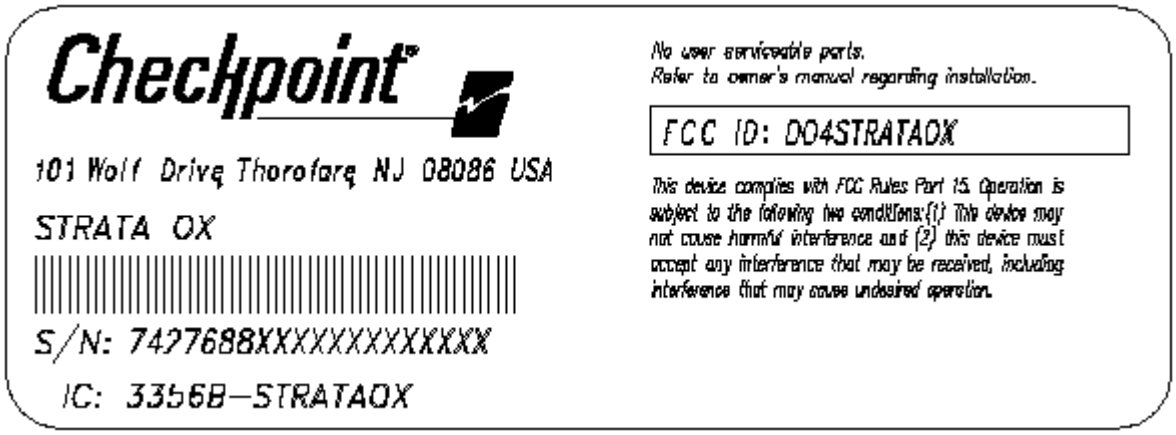


Figure 4 – Sample of Liberty OX Agency Label

Appendix 4 – Correspondence Letter

MAR 13 '97 10:59 TO-912105223396 FROM-CHECKPOINT SYSTEMS INC T-085 P.02/02 F-071
JUL 29 '96 15:19 TO-918013443060 FROM-CHECKPOINT SYSTEMS INC T-031 P.01/02 F-074

CHECKPOINT SYSTEMS, INC.

FACSIMILE TRANSMISSION COVER

To: F.C.C. Lab

Date: 7/26/96

Attention: Mr. Ed Gibbons

Fax No: (301) 344-2050

No. of Pages: 2
(Incl. Cover)

From: Mr. Gregory E. Sleet
CHECKPOINT SYSTEMS, INC.
101 WOLF DRIVE, P.O. BOX 188
THOROFARE, N.J. 08086

Telephone: (609) 384-2339 Direct
Toll Free: (800) 257-8540 Ext. 2339
Fax. No.: (609) 384-2366

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Dear Mr. Gibbons:

Following up on our recent phone conversations, please confirm and if necessary correct our understanding of the points discussed below. Based on the details of our fax dated 7/3/96:

✓ • Our pulsed emissions will be treated as frequency hoping, where the bandwidth will be considered the spectrum contained between the lowest and highest carrier frequency we pulse.

✓ • A simple ratio of the maximum single restricted band infringed upon divided by the bandwidth of our fundamental emission must be less the 1% to satisfy section 15.205 of the rules.

→ • For fundamental and harmonic emissions ~~below 30 MHz~~, a 20 dB reduction from the true peak is to be compared to the limits of 100uV/meter ~~and 30uV/meter respectively~~ at 30 meters. The unit is modulated as normally installed. True peak refers to the point at which the analyzer bandwidth is adjusted for minimum pulse desensitization.

→ • For ~~harmonics above 30 MHz~~ CISPR quasi-peak measurements will be made with the unit modulating as normally installed. Based on the bandwidth plot, care must be given to measure multiples of the worst case emission points. Limits are as specified in section 15.209.

✓ • Conducted emissions remain as specified in part 15 of the rules.

Ed Gibbons
8/2/96