UNISYS

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

ELECTROMAGNETIC COMPATIBILITY TEST REPORT

Doc.20000413R/Project No. 460

TEST STANDARD - USA CFR 47 PART 15

STRATA MX ELECTRONIC ARTICLE SURVEILANCE DETECTION SYSTEM
FCC ID: DO4STRATAMX

CHECKPOINT SYSTEMS, INC.
THOROFARE, NJ

Test Date: 1/28/00, 2/2/2000, 3/7/2000
Issue: April 19, 2000

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ACCREDITED AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

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 MX 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 Intentional Radiator	FCC Part 15.207	450 kHz to 30 MHz	Below Max. Permissible Limit

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1.0 Client Information

Client Name:	Checkpoint Systems, Inc. 101 Wolf Drive Thorofare, NJ 08086
Coordinator(s):	Eric Eckstein
PCTC Test Personnel:	Paul Banker Ray Rashid

1.1 Requested Service

- Measurement of radio disturbance characteristic of sample product to FCC Part 15.223 for intentional 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 MX is an Electronic Article Surveillance System (EAS). The system detects target tags attached to merchandise. The targets resonate in the region of 8.2 MHz. When an article of merchandise is purchased, the target is deactivated which causes it to no longer resonate. The Strata MX system monitors an area 3-feet on either side of the antenna in the 7.6 to 8.7 MHz

The Strata MX utilizes the Model 4022 *61 Printed Circuit Board (PCB). Checkpoint Systems, Inc. manufactures several different types of antennae that are used with the 4022 PCB, this particular model, the MX, is constructed of metal. The Strata system is a transceiver with a 3-loop, 2-loop and 1-loop antenna design. The 1-loop is used as a shield and is tied to ground. This antenna design provides the system with different views of the detection field. It also eliminates “holes” typically found at the crossbars of typical swept antennae.

The Strata System consists of three main components, the antenna, electronics and the power supply. The antenna is constructed with two “canceling” loop designs consisting of a 2 Loop, a 3 Loop and third Loop which is a “shorted turn” contributing to far-field EM cancellation.

The TR4022 electronics PCB consist of two class D HF transmitters, synchronous I and Q receiver, RF selector switch, DDS and PLL, and a DSP based computer used to detect the presence of the target. All control and subsystem interface signals are generated and controlled by a Field Programmable Gate Array (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 7.6MHz to 8.7MHz (digital sweep). The FPGA loads the DDS with the desired frequency for transmission. The DSP on power-up initializes the FPGA to the frequencies for transmission.

TRANSMITTER OPERATION:

The two transmitters are functionally identical, one is used to drive the canceling 2 Loop and the other to drive the canceling 3 Loop. Each TX is functioning in a push pull, class D mode of operation. The control signals are timed for 64 six microsecond bursts at approximately a 100 hertz rate. The signals are grouped into 16 pairs of frequencies. The frequencies used are dictated by the digital sweep, which are controlled by the FPGA. Each bin is transmitted two times for 6 us each. The pattern of 16 bins is used once for the 2 Loop and then repeated for the 3 Loop, this pattern constitutes the "frame" rate of the Strata System.

The overall duty cycle for transmitter operation is 3.84 percent. This rate is derived by taking the amount of time that the transmitter is operational (2 antenna * 16 bins * 2 blasts per bin * 6 microseconds per blast = 384 microseconds) and dividing it by the frame rate of 100Hz (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.

2.2 Equipment Sample

2.2.1 Identification

A pre-production model of the Strata MX was tested:

Description:	Electronic Article Surveillance System
Model:	Strata MX (with a TR4022 *61 board)
Serial Number	None
Manufacturer:	Checkpoint Systems, Inc.
Received by PCTC:	22 October 1999
Sample type	Pre-production

Photos of the Strata MX individual components can be found below.

Photo 1 – Strata MX

2.2.2 Condition of Received Sample

An evaluation of the Checkpoint, Strata MX 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 requirement at the discretion of the client, regulatory agencies, or other entities.

3.1.1 USA

FCC 47 CFR, part 15, Subpart C, "Intentional Radiators ", Clause 15.223. Radiators operating in the range 1.705MHz to 10 MHz..

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, 1992 “ 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 9.8 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 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 MX 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 MX antenna every 5 seconds to initiate a verification cycle. During this cycle, the Strata MX 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.

The Strata MX utilizes the Model TR4022 *61 Printed Circuit Board (PCB). Checkpoint Systems, Inc. manufactures several different types of antennae that are used with the TR4022 PCB, this particular model, the MX, is constructed of metal. The Strata system is a transceiver with a 3-loop, 2-loop and 1-loop antenna design. The 1-loop is used as a shield and is tied to ground. This antenna design provides the system with different views of the detection field. It also eliminates "holes" typically found at the crossbars of typical swept antennae.

The TR4022 electronics PCB consist of two class D HF transmitters, synchronous I and Q receiver, RF selector switch, DDS and PLL, 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 Field Programmable Gate Array (FPGA).

The Direct Digital Synthesizer (DDS) generates a sequence of 16 discrete frequencies from 7.6 MHz to 8.7 MHz (digital sweep). The FPGA loads the DDS with the desired frequency for transmission. The DSP on power-up initializes the FPGA to the frequencies for transmission.

The two transmitters are functionally identical, one is used to drive the canceling 2 Loop and the other to drive the canceling 3 Loop. Each TX is functioning in a push pull, class D mode of operation. The control signals are timed for 64 six microsecond bursts at approximately a 100 hertz rate. The signals are grouped into 16 pairs of frequencies. The frequencies used are dictated by the digital sweep, which are controlled by the FPGA. Each bin is transmitted two times for 6 us each. The pattern of 16 bins is used once for the 2 Loop and then repeated for the 3 Loop, this pattern constitutes the "frame" rate of the Strata System.

The overall duty cycle for transmitter operation is 3.84 percent. This rate is derived by taking the amount of time that the transmitter is operational (2 antenna * 16 bins * 2 blasts per bin * 6 microseconds per blast = 384 microseconds) and dividing it by the frame rate of 100Hz (10 milliseconds) .

The TR4022 is a digital swept frequency hopping transmitter. The TR4022 hops on discrete frequencies. The frequencies that can be transmitted by the TR4022 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

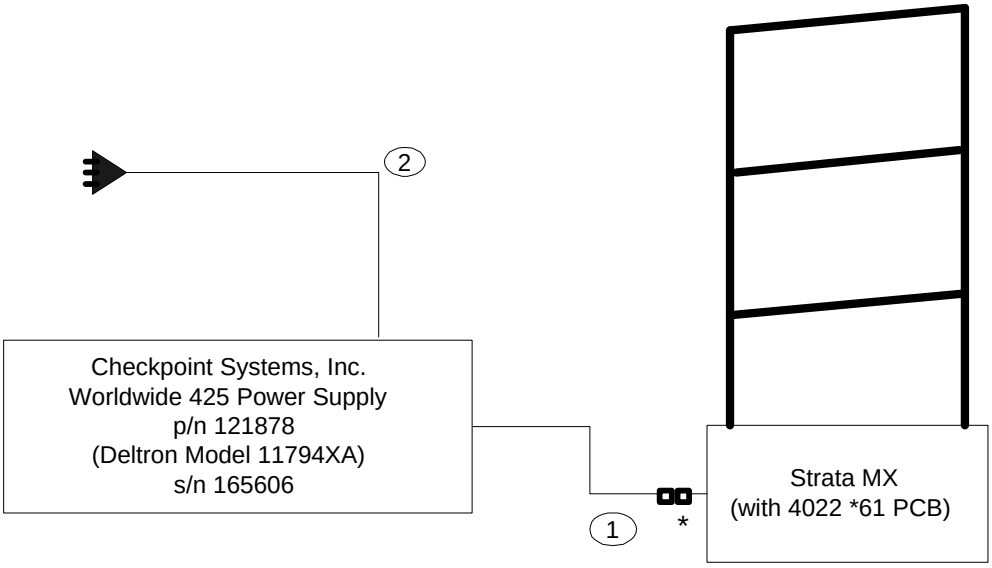
The restricted frequency bands (per FCC Part 15 Clause 15.205) in the operating frequency band of the EUT are as follows:

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.

5.4 Test Configurations

All testing described in this report was performed with the EUT in a single equipment configuration as shown below. This configuration consisted of the Strata MX with 4022 *61 board and a power supply, Model Wordwide 425 Detron, serial number 165606. The drawing shows the block diagram of the tested configuration used for the EMI test, the I/O cables connected and AC power distribution.



CABLE LIST

1. DC Power Cable, 24', shielded (*with 4 twisted-pair ferrite beads and two turns through Fair-rite #80640 clamp-on)

2. AC Line Cord, 7', Eupen #E137991, shielded

Figure 1 – EUT Configuration Diagram for Strata MX EMC Testing

5.4.1 Support Equipment

No equipment was used to support the operation of the Strata MX during testing.

5.5 EUT Modifications

Compliance was achieved after ferrite blocks were added in the following locations.

1. Fair Rite P/N 2865000202 – Add 2 each to the two antenna leads.
2. Fair Rite P/N 2865000202 – Add 4 to the DC Power Lead.
3. Fair Rite P/N 2865000202 – Add 1 to the Speaker lead with three turns through the ferrite.
4. Fair Rite P/N 2865000202 – Add 1 to the Alarm Light lead with two turns through the ferrite.

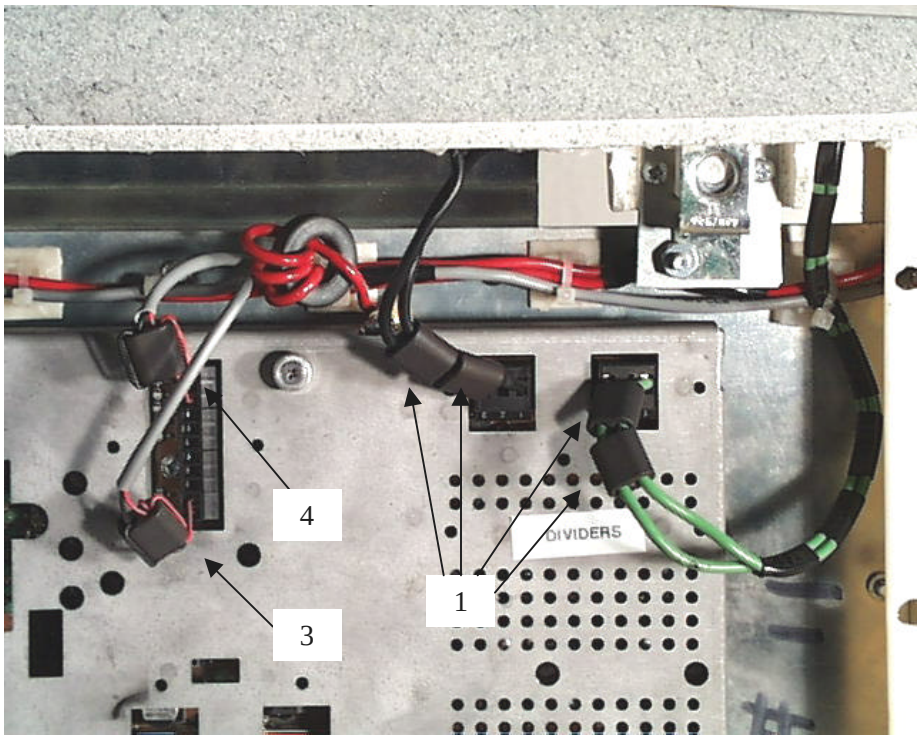


Photo 2 – Ferrite Locations

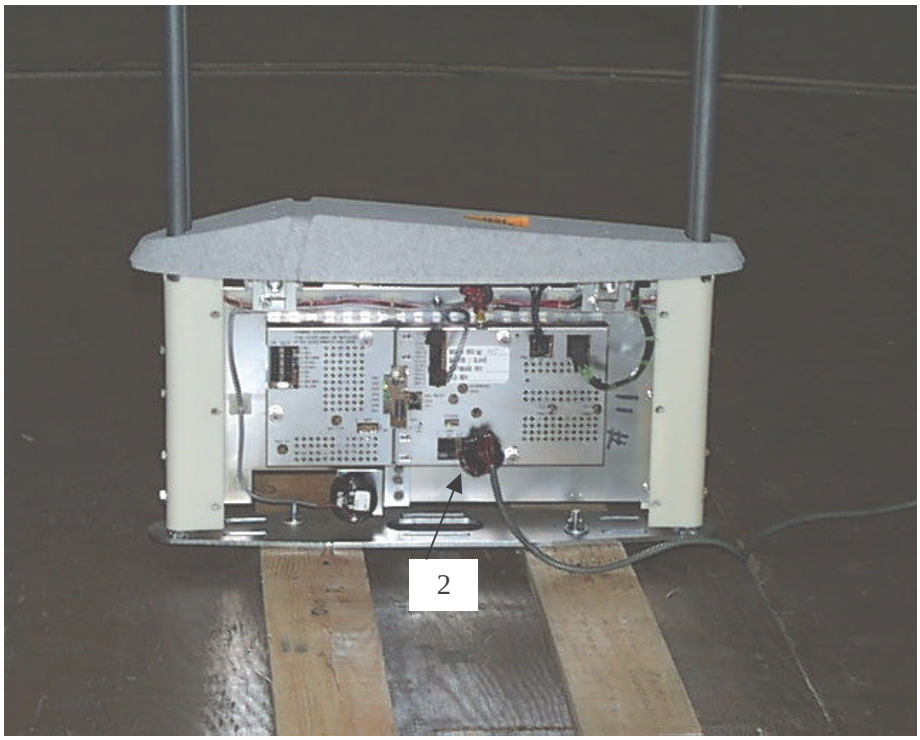


Photo 3 – Ferrite Locations

6.0 Summary Of Test Results

6.1 Emission Tests

6.1.1 Radiated Emission Test (3/7/2000)

Tables 1, 2 and 3 below show the detected field strengths as measured from the EUT(s) over the frequency range from 7.6 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 measuring antenna 1 meter above the ground plane. A description of the procedures used in the performance of this test is provided in Appendix 2.

Table 1 shows the true peak measurement of the fundamental and the comparison of the adjusted true peak to the average limit.

Table 1 – Fundamental Measurement – True Peak (28 Jan, 2000)

Freq [MHz]	Height, Pol[1] [cm 1/2/3]	Angle [Deg]	Peak Detector Voltage [dBuV]	Corr' Factor [dB/m] (2)	Field Strength [dBuV/m]	FCC Average Limit @ 30m [dBuV/m]	Delta Limit [dB]
7.892 Fund*	100,3	90	60 Peak	-21.8	38.2	40	-1.80

*The true peak signal level of the fundamental was measured using a peak detector as described in section 4.0.

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

2) The correction factor shown represents an antenna factor of –1.8 dB/m and the 20 dB reduction as specified in the measurement procedure.

MEASUREMENT RESULT -- AVERAGE

As indicated earlier, the transmitter operates with a duty cycle of 3.84%. This would result in the following calculations for conversion from peak to average and a subsequent comparison of the fundamental with the average limit.

Table 2 – Calculated Average vs. Average Limit

True Peak:	60.0 dBµV
Pulse Duty Cycle:	3.84%
Correction to Average: 20 * Log_{10} (Duty Cycle)	-28.3 dB
Average Level: (True Peak + Correction)	31.7 dBµV
Antenna Correction:	-1.2 dB/m
Corrected Average Field Strength:	31.7 dBµV + (-1.2 dB/m) = 30.5 dBµV/m
Limit:	40 dBµV/m
Margin with Limit:	-9.5 dB

Table 3 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.

Table 3 – H-Field Emissions (< 1.705 MHz and > 10 MHz) (28 Jan, 2000)

Freq [MHz]	Height, Pol[1] [cm 1/2/3]	Angle [Deg]	Quasi-Peak Voltage [dBuV]	Corr' Factor [dB/m]	Field Strength [dBuV/m]	FCC QP Limit @ 30m [dBuV/m]	Delta Limit [dB]
16.20	100,3	0	18.5	1.5	20.0	30	-10.0
24.4	100,3	0	15.5	1.1	16.6	30	-13.4

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

Table 4 below shows the detected field strengths as measured from the EUT(s) over the frequency range from 30 MHz to 1000 MHz, at a distance of 3 meters compared to the maximum permissible FCC limit at 3 meters. A description of the procedures used in the performance of this test is provided in Appendix 2.

Table 4 – E-Field Emissions (30 MHz to 1000 MHz) (3 Mar, 2000)

Freq [MHz]	Height, Pol [cm H/V]	Angle [Deg]	Quasi-Peak Voltage [dBuV]	Corr' Factor [dB/m]	Field Strength [dBuV/m]	FCC QP Class B Limit @ 3m [dBuV/m]	Delta Limit [dB]	Result
664.005	100, V	186	16	24	40.0	46.0	-6.0	Below limit
668.384	100, H	85	9.9	24.1	34.0	46.0	-12.0	Below limit
668.580	252, V	198	8	24.1	32.1	46.0	-13.9	Below limit
839.980	100, H	314	16.7	26.5	43.2	46.0	-2.8	Below limit
844.791	100, H	214	6.9	26.5	33.4	46.0	-12.6	Below limit
888.001	100, H	301	7.1	27.0	34.1	46.0	-11.9	Below limit
897.630	127, H	41	7.3	27.2	34.5	46.0	-11.5	Below limit

- Overall Result: All measured radiated emissions from the Strata MX are below the FCC 15.223 and 15.209 limits by a margin of at least 2.8 dB.

Digital circuitry related signals 30 to 1000 MHz – FCC 15.109b

Table 5 below shows the detected field strengths as measured from the EUT over the frequency range from 30 MHz to 1000 MHz, 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 5 – E-Field Emissions Related to Digital Circuitry (3 Mar, 2000)

Freq [MHz]	Height, Pol [cm H/V]	Angle [Deg]	Quasi-Peak Voltage [dBuV]	Corr' Factor [dB/m]	Field Strength [dBuV/m]	FCC QP Class B Limit @ 3m [dBuV/m]	Delta Limit [dB]	Result
319.989	316, H	315	7.9	17.1	25.0	46.4	-21.4	Below limit
800.002	292, H	30	9.9	26.0	35.9	46.4	-10.5	Below limit
839.976	388, H	317	9	26.5	35.5	46.4	-10.9	Below limit
920.027	368, H	318	6.2	27.5	33.7	46.4	-12.7	Below limit
959.978	302, H	310	13.1	27.6	40.7	46.4	-5.7	Below limit
999.979	396, H	307	10.5	28.3	38.8	47.0	-8.2	Below limit

- Overall Result: All measured radiated emissions from the Strata MX are below the FCC Class A limits by a margin of at least 5.7 dB.

Photo 4 -- Strata MX Radiated Emissions Test Setup – Front View

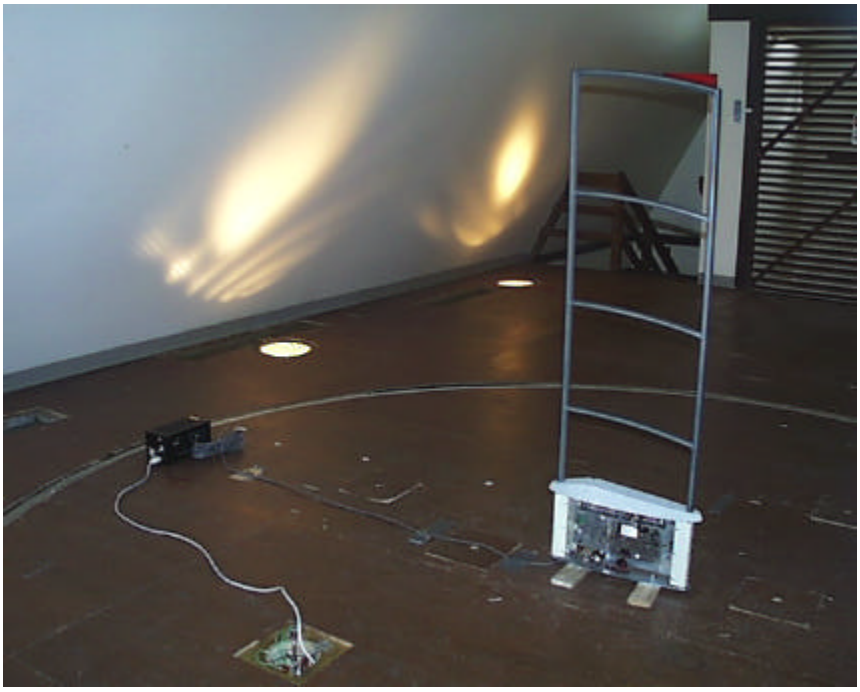


Photo 5 -- Strata MX Radiated Emissions Test Setup – Rear View

6.1.2 Bandwidth Measurement (1/28/2000)

A plot of the operating bandwidth was taken on the operating Strata MX by placing the measuring antenna close to the EUT, setting a spectrum analyzer to 10 dB/div, RBW=VBW=300 kHz, span = 7.2 to 9.2 MHz, Peak detection, max hold. This plot is shown below.

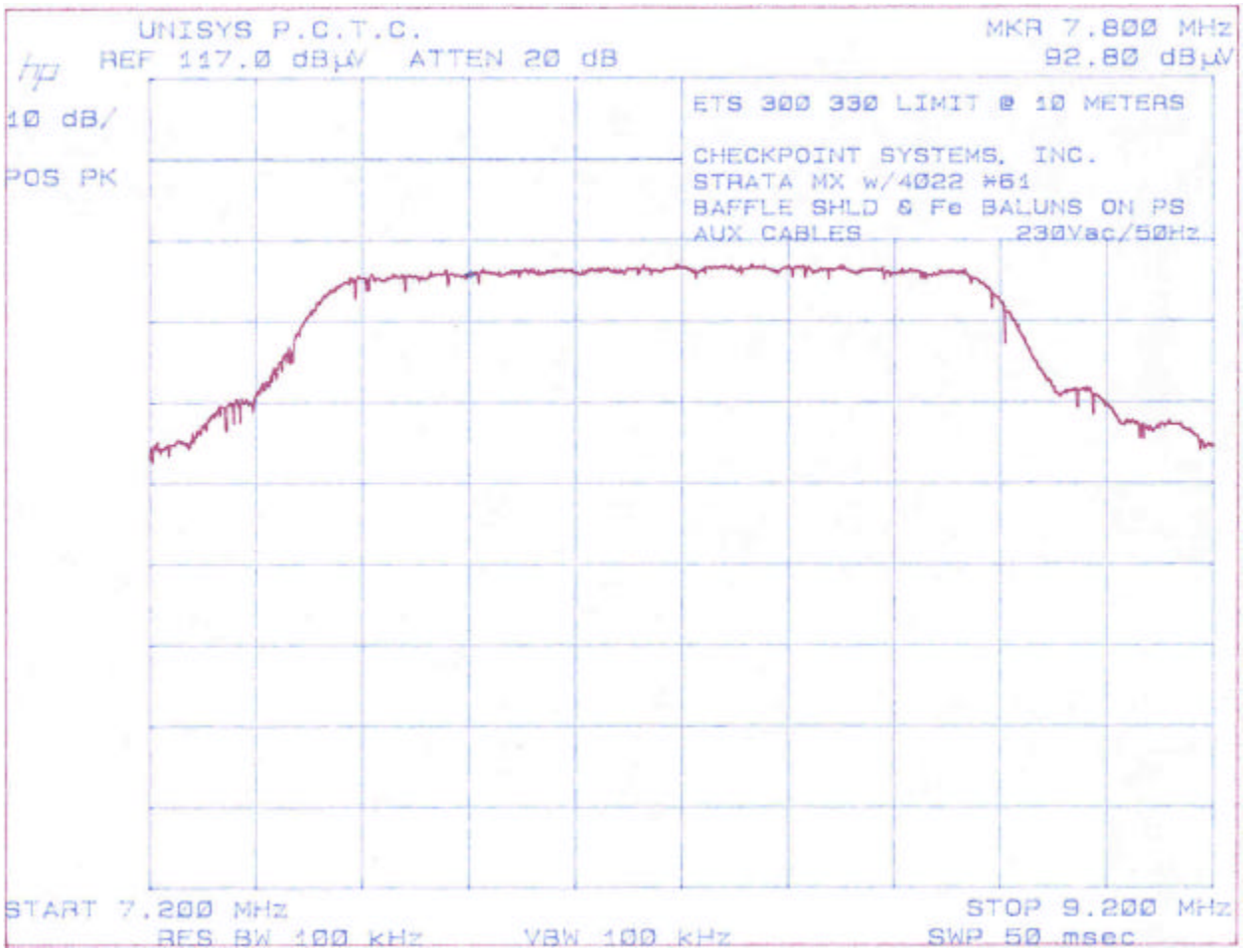


Photo 6 – Bandwidth Plot

The plot above confirms the transmitter bandwidth is 1.2 MHz as stated by the manufacturer. The bandwidth is 14.6% of the fundamental (8.2 MHz / 1.2 MHz) and therefore per FCC Section 15.223, the limit of 100 uV/m applies for emissions between 1.705 MHz and 10 MHz.

6.1.3 Conducted Emission Test (2/2/2000)

The following tables show the conducted emissions measurement results for the EUT for devices operating under FCC 15.223, where the limit of FCC 15.209 applies. A description of the procedures used in the performance of this test is provided in Appendix 2.

- Wordwide 425Deltron Power Supply, Neutral Line 120VAC/60Hz

Table 6 – Conducted Emissions, Neutral Line (2 Feb, 2000)

	Amplitude		FCC Limit for Intentional Radiators		Margin w/ Limit		
Frequency (MHz)	Q-P Detector (dBuV)	Average Detector (dBuV)	Q-P (dBuV)	Wideband Limit (dBuV)	Q-P (dBuV)	Wideband (dBuV)	Corr. Factor
7.731 *	44.1	23.4	48.0	61.0	-3.9	-37.6	10.4
7.804 *	44.3	23.6	48.0	61.0	-3.7	-37.4	10.5
7.820 *	44.4	23.7	48.0	61.0	-3.6	-37.3	10.5
7.836 *	44.2	23.7	48.0	61.0	-3.8	-37.3	10.5
7.851 *	44.0	23.6	48.0	61.0	-4.0	-37.4	10.5
7.878 *	44.5	24.0	48.0	61.0	-3.5	-37.0	10.4
7.909 *	44.4	23.7	48.0	61.0	-3.6	-37.3	10.4
7.936 *	44.4	23.9	48.0	61.0	-3.6	-37.1	10.4
7.951 *	44.6	24.0	48.0	61.0	-3.4	-37.1	10.4
7.967 *	44.5	23.9	48.0	61.0	-3.5	-37.1	10.4
7.983 *	44.4	23.8	48.0	61.0	-3.6	-37.2	10.4
8.009 *	44.3	23.9	48.0	61.0	-3.7	-37.1	10.4
8.024 *	44.5	24.0	48.0	61.0	-3.5	-37.0	10.4
8.040 *	44.5	23.9	48.0	61.0	-3.5	-37.1	10.4
8.056 *	44.4	23.9	48.0	61.0	-3.6	-37.1	10.4
8.056 *	44.3	23.7	48.0	61.0	-3.7	-37.3	10.4
8.082 *	44.2	23.9	48.0	61.0	-3.8	-37.1	10.4
8.097 *	44.4	23.9	48.0	61.0	-3.6	-37.1	10.4
8.129 *	44.0	23.5	48.0	61.0	-4.0	-37.5	10.4

Note: * This is a wideband signal therefore it was remeasured using a WB detector and compared to the WB limit.

- Wordwide 425Deltron Power Supply, Phase Line 120VAC/60Hz

Table 7 – Conducted Emissions, Phase Line (2 Feb, 2000)

	Amplitude		FCC Limit for Intentional Radiators		Margin w/ Limit		
Frequency (MHz)	Q-P Detector (dBuV)	Wideband (dBuV)	Q-P (dBuV)	Wideband Limit (dBuV)	Q-P (dBuV)	Wideband (dBuV)	Corr. Factor
7.658 *	44.9	23.7	48.0	61.0	-3.1	-37.3	10.4
7.673 *	44.6	24.0	48.0	61.0	-3.4	-37.0	10.5
7.747 *	45.3	24.4	48.0	61.0	-2.7	-36.6	10.5
7.762 *	45.1	24.4	48.0	61.0	-2.9	-36.6	10.5
7.773 *	44.9	24.5	48.0	61.0	-3.1	-36.5	10.5
7.789 *	45.3	24.5	48.0	61.0	-2.7	-36.5	10.5
7.820 *	45.3	24.5	48.0	61.0	-2.7	-36.5	10.5
7.836 *	45.2	24.6	48.0	61.0	-2.8	-36.4	10.5
7.846 *	45.1	24.6	48.0	61.0	-2.9	-36.4	10.5
7.862 *	45.5	24.9	48.0	61.0	-2.5	-36.1	10.5
7.893 *	45.6	24.9	48.0	61.0	-2.4	-36.1	10.5
7.910 *	45.4	24.6	48.0	61.0	-2.6	-36.4	10.5
7.925 *	45.3	24.6	48.0	61.0	-2.7	-36.4	10.5
7.951 *	45.8	24.1	48.0	61.0	-2.2	-36.9	10.5
7.966 *	45.7	24.8	48.0	61.0	-2.3	-36.2	10.4
7.982 *	45.4	24.8	48.0	61.0	-2.6	-36.2	10.4
7.998 *	45.1	24.5	48.0	61.0	-2.9	-36.5	10.4
8.040 *	45.6	24.8	48.0	61.0	-2.4	-36.2	10.4
8.056 *	45.3	24.6	48.0	61.0	-2.7	-36.4	10.4
8.067 *	44.9	25.0	48.0	61.0	-3.1	-36.0	10.4
8.114 *	45.2	24.6	48.0	61.0	-2.8	-36.4	10.4
8.145 *	44.7	24.1	48.0	61.0	-3.3	-36.9	10.5
8.202 *	44.9	24.3	48.0	61.0	-3.1	-36.7	10.5
8.228 *	44.8	24.3	48.0	61.0	-3.2	-36.7	10.5
8.275 *	44.7	24.1	48.0	61.0	-3.3	-36.9	10.4

Note: * This is a wideband signal therefore it was remeasured using a WB detector and compared to the WB limit.

- Overall Results:

  - The Strata MX complied with the requirements of FCC 15.207 by a margin of at least 37.8 dB.

Photo 7 – Strata MX Conducted Emissions Test Setup

Appendix 1 – Test Equipment Listing

Radio Disturbance Test Equipment

Equipment	Model	Manufacturer	ID No.	Last Cal Date
QuasiPeak Adapter (10KHz - 1GHz)	85650A	Hewlett Packard	X717	2/9/99
Spectrum Analyzer Display	85662A	Hewlett Packard	X719	3/12/99
Spectrum Analyzer Display	85662A	Hewlett Packard	U181	2/9/99
Spectrum Analyzer (10KHz – 1.5GHz)	8566B	Hewlett Packard	X718	2/9/99
Spectrum Analyzer (10KHz - 1.5GHz)	8568A	Hewlett Packard	U180	3/12/99
RF Preselector (20 Hz to 2GHz)	85685A	Hewlett Packard	Y0312	2/9/99
Manual Receiver (9 kHz-30 MHz)	ESH2	Polarad	U964	12/28/98
Manual Receiver (20 MHz -1GHz)	ESV	Polarad	U965	7/15/99
LISN	8121	Schwarzbeck	Y0691	2/6/99
Antenna (25MHz to 2GHz)	LFB-2025	ARA	B-962	6/23/99

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. Reference the attached drawing for a view of the test facility. The test site complies with the Attenuation Measurements specified in ANSI C63.4 - 1992, and is registered with FCC, VCCI, NEMKO and EZU.

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 from 6.5 to 10.5 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 an manually tuned receiver with the detector function first set to quasi-peak and then to average. These manual measurements are recorded and printed below each graph, which is attached in Appendix 4 of this report.

Appendix 3 – EUT Drawings

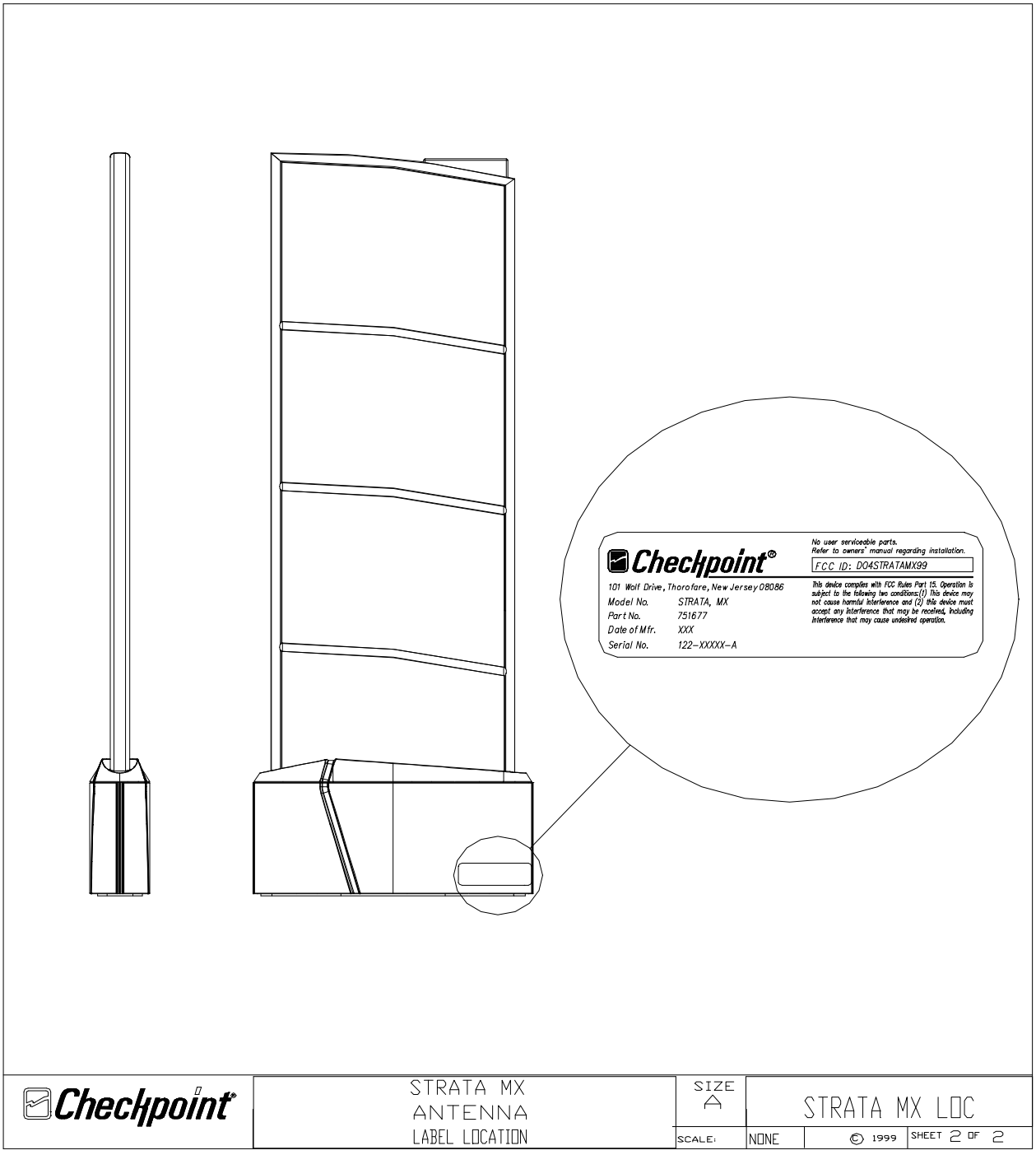


Figure 2 – Strata MX Label Location

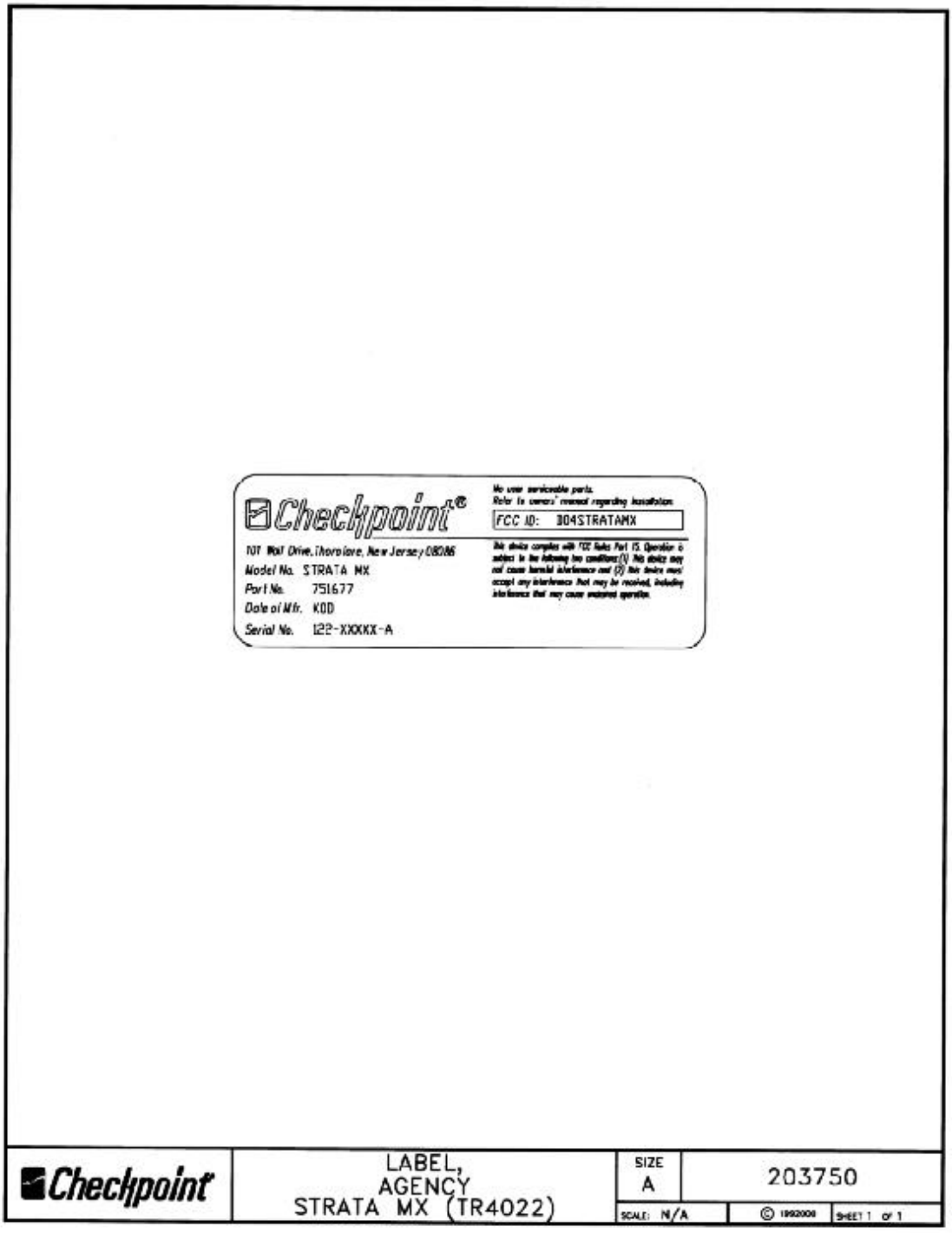


Figure 3 – Strata MX Label

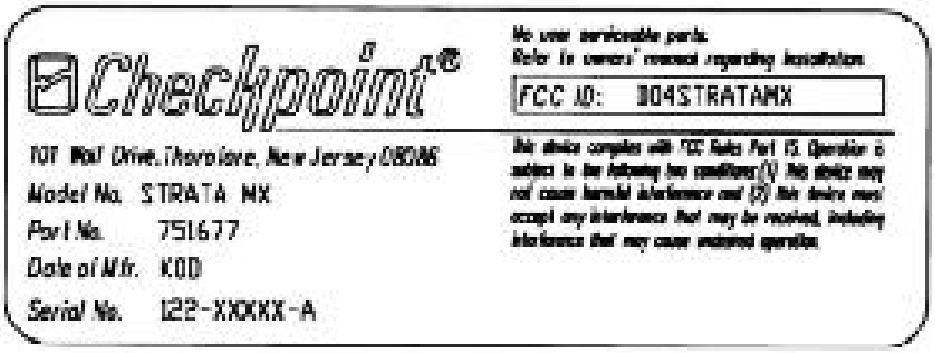


Figure 4 – Close Up of Strata MX Label

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-918013443069 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) 344-2039

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 in the band 1.705 - 10 meter, a 20 dB reduction from the true peak is to be compared to the limits of 100uV/meter 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 emissions outside the 1.705 - 10 meter band, 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