

RADIO DISTURBANCE TEST REPORT


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PORTABLE READER

USA CFR 47 PART 15 REQUIREMENTS

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Sponsor: Checkpoint Systems, Inc.
101 Wolf Drive
Thorofare, NJ 08086

The results described in this report relate only to the item(s) tested.
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PREFACE

This report documents product testing conducted to verify compliance of the specified test sample with applicable standards and requirements as identified herein. Test sample, 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, Portable Reader, as described in Section 2.1, was tested to the standards listed below, and found to have the following characteristics:

TEST	STANDARD	REQUIREMENT	RESULT
Radiated Emissions - Intentional Radiator	FCC 15.225, 15.209	13 MHz - 1 GHz	Below Limit
Radiated Emissions Digital Device	FCC Class B	General Requirements 30 MHz - 1 GHz	Below Limit
Frequency Stability	FCC 15.225	$\pm 0.01\%$	Within Tolerance

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1.0 Client Information

Client Name: Checkpoint Systems, Inc.
101 Wolf Drive
Thorofare, NJ 08086

Coordinator(s): Anthony Mignogna

PCTC Test Personnel: Paul Banker
John Baumeister

1.1 Requested Service

- Measurement of radio disturbance characteristics of sample product to FCC Part 15.225 for intentional radiators operating at 13.553 - 13.567 MHz.
- Measurement of radio disturbance characteristics of sample product to FCC Part 15, Class B for unintentional radiators.
- Measurement of frequency stability characteristics of sample product to FCC Part 15.225 for intentional radiators operating at 13.553 - 13.567 MHz.

1.2 Purpose of Test(s)

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

2.0 Test Item**2.1 Test Sample Identification**

A production model sample of the test item was tested as follows:

Model No./Name:	Portable Reader
Serial Number	None
Manufacturer:	Checkpoint Systems, Inc.
Received by PCTC:	5/7/99

2.2 Condition of the Test Sample

The visual examination of the Portable Reader was carried out for test subject identity and condition. No evidence of physical damages was noticed. The test item condition was acceptable for the performance of the requested test services. One of the coordinators from Checkpoint System was present during the entire test duration for monitoring the test item operation.

2.3 Description of The Test Item

2.3.1 General

The Portable RFID Reader wand is a state of the art design, which collects data from Diamond Checkpoint Read Only RFID tags. The unit is capable of reading one or several tags in the detection zone and storing the tag data in non-volatile memory for later download via an IR link. The device consists of a detection wand, an interconnecting cable and beltpack.

2.4 Test Item Classification

The test item has been defined an intentional radiator operating in the band 13.553 MHz to 13.567 MHz. For this reason the emissions testing was carried out in accordance with the requirements of FCC 15.225. In addition, the test item contains digital control and signal processing circuitry. Signals identified as related to the digital circuitry were compared to the FCC Class B limits for digital devices.

2.5 Test Sample Modifications

A large ferrite bead was removed from the single-board computer ribbon cable during test. The emissions were found to be compliant without this.

2.6 Support Equipment

There was no support equipment necessary or present during testing.

Photos of the test item can be found in Appendix 5.

3.0 Applicable Requirements, Methods And Procedures

3.1 Applicable Requirements

The results of the measurement of the radio disturbance characteristics of the test sample 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

- a) 47 CFR, part 15, Subpart B, "Unintentional Radiators, General Rules and Regulations".
- b) 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:

- 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”.

A listing of test equipment used during this testing is provided in Appendix 1.

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

4.0 Deviations Or Exclusions From The Requirements And Standards

None.

5.0 Operation Of The Test Sample During Testing

5.1 Test Environment

5.1.1 Climatic Environment

Except as noted, the following were the ambient conditions in the laboratory during testing:

Temperature:	22° C ± 1° C
Relative Humidity:	50% RH

5.1.2 Electrical Power

Except as noted, the test sample was operated with a freshly charged battery.

5.2 Grounding

There was no ground connection to the test sample.

5.3 Operating Mode

During EMI testing, the Portable Reader was continuously transmitting and monitoring for the presence of an ID tag.

5.4 Test Configurations

Refer to Appendix 3 for the photos of the test setup and drawings of EMI test configuration. The drawing shows the physical hardware layout used for the EMI tests along with I/O cables connection and AC power distribution. A description of any external interface cable present during the test is attached to this drawing for reference.

6.0 Summary Of Test Results**6.1 Emission Tests****6.1.1 Radiated Emission Test (5/7/99)****Transmitter related signals 13 - 30 MHz - FCC 15.225, 15.209**

The table below shows the detected field strengths as measured from the test sample(s) over the frequency range from 13 MHz to 30 MHz, at a distance of 30 meters compared to the maximum permissible FCC limit at 30 meters for signals and harmonics of an intentional radiator. A detailed description of the procedures used in the performance of this test is provided in Appendix 2. A detailed description of the procedures used in the performance of this test is provided in Appendix 2.

Freq [MHz]	Voltage/ Detector [dBuV]	Corr' Factor [dB/m]	Field Strength [dBuV/m]	FCC Limit @ 30m [dBuV/m]	Delta Limit [dB]	Result
13.56	62.4 Peak	-1.2	61.2	80	-18.8	Below 15.225 limit
27.12	13.8 QP	+1.73	15.53	29.5	-13.97	Below 15.209 limit

- Overall Result: All measured transmitters related radiated emissions below 30 MHz from the Portable Reader are below the FCC limits by a margin of 13.97 dB.

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Product Compliance Test Center

Signals 30 to 1000 MHz - FCC 15.109b

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

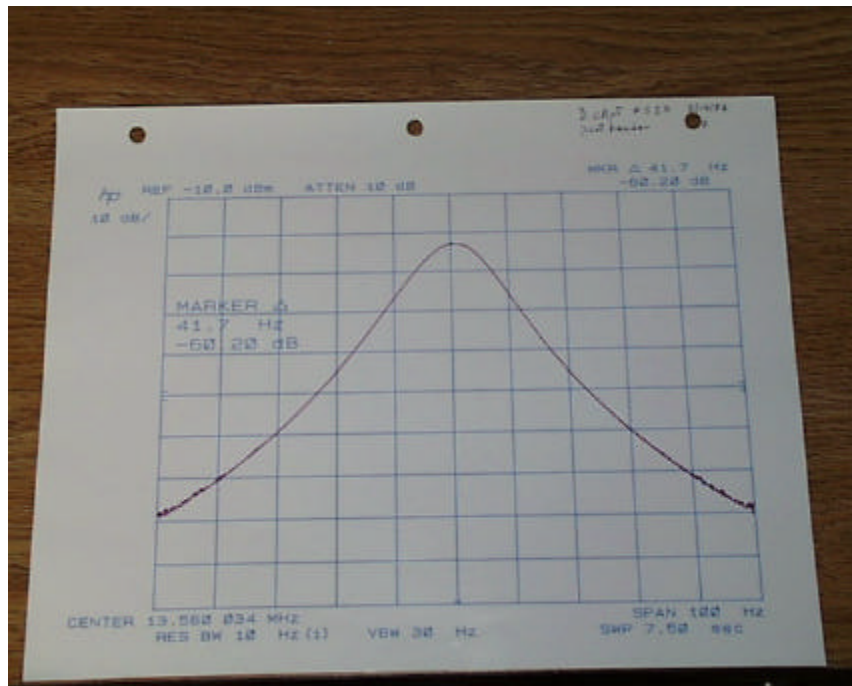
Portable Reader Without Ribbon FE:

Freq [MHz]	Height, Pol [cm H/V]	Angle [Deg]	Quasi-Peak Voltage [dBuV] Detector	Corr' Factor [dB/m]	Field Strength [dBuV/m]	FCC Class B Limit @ 3m [dBuV/m]	Delta Limit [dB]	Result
65.995	100,V	67	22.8	12.8	35.6	40.0	-4.4	Below limit
200.007	116,H	17	16.8	13.8	30.6	43.5	-12.9	Below limit
239.990	105,H	45	27	15.8	42.8	46.0	-3.2	Below limit
279.991	102,H	2	15.5	16.8	32.3	46.0	-13.7	Below limit
320.004	100,H	48	24.7	18.1	42.8	46.0	-3.2	Below limit
359.994	100,H	360	14.8	19.4	34.2	46.0	-11.8	Below limit
519.991	100,V	203	7.3	22.4	29.7	46.0	-16.3	Below limit

- Overall Result: All measured radiated emissions from the Portable Reader without ribbon FE are below the FCC Class B limits by a margin of 3.2 dB.

Transmitter fundamental spectral plot (5/19/99)

The following plot shows the bandwidth of the transmitter fundamental. The -60 dB bandwidth is approximately 82 Hz. The signal was measured using a small wire-loop probe connected to a spectrum analyzer placed near the test item.



6.2 Frequency Stability Tests (5/19/99)

The following table shows the frequency deviation measured on a sample of the transmitter board compared to FCC 15.225 limits of .01% with respect to temperature. A freshly charged battery was installed prior to testing. A detailed description of the procedures used in the performance of this test is provided in Appendix 2.

Condition	Time[min]	Frequency[Hz]	% Deviation from nominal	Result
20°C	0	13560021	nominal	nominal
	2	13560025	<<0.01%	Below limit
	5	13560030	<<0.01%	Below limit
	10	13560034	<<0.01%	Below limit
50°C	0	13560019	<<0.01%	Below limit
	2	13560032	<<0.01%	Below limit
	5	13560047	<<0.01%	Below limit
	10	13560073	<<0.01%	Below limit
-20°C	0	13560013	<<0.01%	Below limit
	2	13560032	<<0.01%	Below limit
	5	13560028	<<0.01%	Below limit
	10	13560028	<<0.01%	Below limit

- Overall Results: The Portable Reader complied with the requirements of FCC 15.225 for frequency stability by a worst case deviation from nominal of 52 Hz or $100 \times 52 / 13560021 = 3.8E-4$ %.

Appendix 1 - Test Equipment Listing

Radio Disturbance Test Equipment

<u>Equipment</u>	<u>Model</u>	<u>Manufacturer</u>	<u>ID No.</u>	<u>Last Cal Date</u>
Spectrum Analyzer QuasiPeak Adapter	85650A	Hewlett Packard	U182	3/16/98
Spectrum Analyzer Display	85662A	Hewlett Packard	X719	3/16/98
Spectrum Analyzer Display	85662A	Hewlett Packard	Y0314	2/19/99
Spectrum Analyzer Display	85662A	Hewlett Packard	U181	9/29/98
Spectrum Analyzer	8566B	Hewlett Packard	Y0313	2/19/99
Spectrum Analyzer	8568B	Hewlett Packard	X718	9/29/98
Spectrum Analyzer	8568B	Hewlett Packard	U180	3/16/98
RF Preselector	85685A	Hewlett Packard	W927	3/16/98
Manual Receiver 9 kHz-30 MHz	ESH2	Polarad	U964	12/28/98
Manual Receiver 20 - 1000 MHz	ESV	Polarad	U965	6/8/98
Antenna 30 - 1500 MHz	LPB2520	ARA	B926	4/30/98
Antenna 100 Hz to 100 MHz	BBH-500/B	ARA	U640	6/5/98
LISN	MN2053	Chase	U775	8/18/98
Temperature/Humidity chamber	SM32C	Thermotron	V733	7/17/98

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****9kHz to 30 MHz**

Testing below 30 MHz was performed with the test item configured on the test site as above. An H-field measuring antenna was placed at a distance of 30 meters from the test item at a height of 1 meter above the ground plane. The test item 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.

30MHz to 1GHz

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 test sample and support peripherals or devices required to facilitate test sample 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.

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 test sample(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.

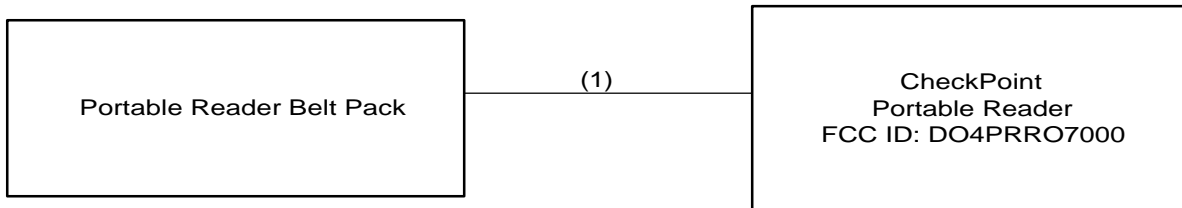
The source of questionable emissions was verified by powering off the test sample(s). Those emissions remaining were removed from the suspect list. Valid suspect emissions were then maximized through cable manipulation. The highest six signals or all within 4 dB of the limit, identified during this initial 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 test sample(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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} = & \text{meter reading (dBuV)} \\ & + \text{antenna factor (dB/m)} \\ & + \text{Cable Loss (dB)} \end{aligned}$$

A.2.1.2 Frequency Stability Test

The test sample was placed in an environmental chamber at 20°C and allowed to stabilize (minimum 30 minute soak). The test sample was then powered on. The nominal operating frequency was measured at this time with a small loop probe connected to a spectrum analyzer. Measurements were also made at 2, 5 and 10 minutes after power on. This procedure was repeated for all required temperature and voltage conditions.

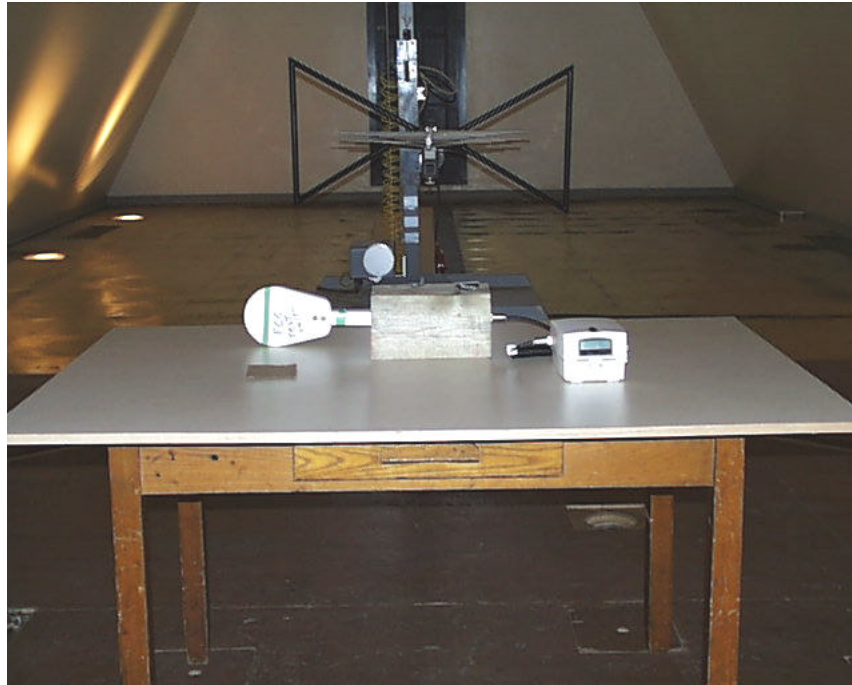
Appendix 3 - Test Sample Configuration Drawings/Photographs



Above Groundplane

1. Checkpoint, shielded, 24”.

Block Diagram For Portable Reader - EMI Testing



Portable Reader - Radiated EMI Test Setup