

ELECTROMAGNETIC INTERFERENCE TEST REPORT

Doc. 20011210R Project No. 606

**TEST STANDARD: 47 CFR PART 15C,
INTENTIONAL RADIATORS**

**PERFORMA PORTABLE READER
FCC ID: DO4PRRO7100**

**CHECKPOINT SYSTEMS
THOROFARE, NEW JERSEY**

**TEST DATES: 12/3/01 – 12/7/01
ISSUE: 12/12/01**

Prepared by: *Paul Banker*
Paul Banker
Technical Staff Engineer

Approved by: *John Baumeister*
John Baumeister
Group Manager, PCTC/ICC

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AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

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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 in 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 Performa Portable Reader was tested to the standards listed below, and found to have the following characteristics:

Emission Tests

| TEST | STANDARD | REQUIREMENT | RESULT |
|---------------------|------------------|---|---------------------------------|
| Radiated Emissions | 47 CFR Part 15 C | 10 kHz – 1 GHz | Below Max. Permissible limit |
| Frequency Stability | 47 CFR Part 15 C | Carrier Frequency tolerance of ± 01 % at -20°C and $+50^{\circ}\text{C}$. | Below Max. Permissible limit |

EUT Modifications

The Symbol 18" I/O cable was modified. A 6.8- μH choke was added in series with the ground connection between the RJ41 connector and the reader end of the PPT cable. This modification was necessary to comply with the radiated emissions limits of 47 CFR Part 15C.

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1.0 Description of The Equipment Under Test (EUT)

| | |
|---------------------------------|--|
| Equipment Identification | RFID Portable Reader |
| Model / Part Number | Performa Portable / 942014 |
| Serial Number | none |
| Manufacturer | Checkpoint Systems, Inc., 101 Wolf Drive, Thorofare, NJ 08086 |
| Technical Contact | Anthony Mignogna |
| Condition Received | Acceptable for Test |
| Date Received | 11/30/01 |
| Sample Type | Pre-production Unit |
| Equipment Classification | Professional Use Information technology Equipment (ITE) |
| Unisys Test Personnel | Paul Banker |

Unless otherwise noted in the individual test results sections, testing was performed on the EUT configured as follows.

1.1 General Description

The Performa Portable Reader or the Intelligent Library System (ILS) Inventory Wand is a key component in Checkpoint's family of ILS products. Consisting of a lightweight, handheld sensing unit, the Inventory Wand combines convenience with versatility. An extendable handle makes it easy to read items placed in hard-to-reach areas, while the sophisticated antenna design and electronics make the Inventory Wand the longest-range portable reader available. This feature is exceptional when checking inventory or trying to locate materials that haven't been shelved properly.

The ILS Inventory Wand is designed with ease of use in mind. The handheld antenna contains three LED's: the green light indicates power "on", the red light alerts the user that a Circulation Circuit is being read, and the yellow one indicates a low battery.

The ILS Inventory Wand enables a fast, efficient and accurate method for taking inventory of the library material.

The Portable Data Terminal (PPT 2700) enables data to be uploaded or downloaded from the ILS Application Server, providing both inventory and search capability.



1.2 Test Configurations

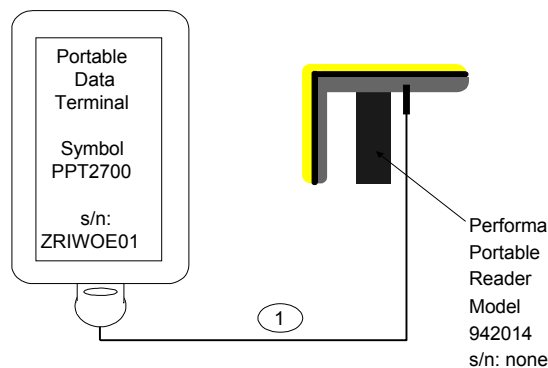
Testing was carried out on the configuration identified below.

1.3 Rationale for The Chosen Configuration

The selected configuration represents a typical customer system to be delivered for the CS7822 ClearPath Plus application.

1.4 Block Diagram and Cable Listing

A block diagram of the EUT configuration showing interconnection cables is shown on the next page for reference. The drawing shows the physical hardware layout used for the 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.



| Reference Designation | Cable Function | Cable Type | Cable Length |
|-----------------------|-----------------------|------------|--------------|
| 1 | Synchronization Cable | Shielded | 18" |

1.5 EUT Details

| Test or Support Item (T/S) | Description | Manufacturer | Model/Part Number | Serial Number |
|----------------------------|--------------------------|--------------------------|-------------------|---------------|
| T | Portable Reader | Checkpoint Systems, Inc. | 942014 | None |
| S | Personal Pocket Terminal | Symbol | PPT-2700 | ZRWIOE01 |

2.0 Operation Of The EUT During Testing

Unless otherwise noted in the individual test results sections, testing was performed on the EUT as follows.

2.1 General**Climatic Environment**

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

Temperature: 22° C ± 5° C Relative Humidity 50% ± 10% RH

Selection of Power Voltage/Frequencies

The Performa Portable Reader operates with power from an 11.2 Volt, Li Ion, 1.4 Ampere/Hour rechargeable battery. Testing was performed with a fully charged battery.

2.2 Operating Modes

The Performa Portable Reader was connected to the Portable Data Terminal, Symbol Model PPT 2700, for all testing. An RFID tag was presented to the reader and data was gathered and transmitted to the PPT 2700 using the RS232 interface. The device was tested in a standby mode, without an RFID tag present and in a read mode, with the RFID tag present.

2.3 Rationale for The Chosen Mode of Operation

The selected operating mode of the Performa Portable Reader represents system activities similar to normal operation activities of data transmission/receiving/processing and therefore constitutes

an appropriate test mode. The selected test configuration duplicates the use of the Performa Portable Reader by customers that may encounter EMC immunity concerns or cause emissions under worst-case conditions.

3.0 Applicable Requirements

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

USA

47 CFR, Part 15, Subpart C, "Intentional Radiators"

3.1 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:

- CISPR Publication 22: 1993, A1: 1996; A2: 1996; "Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods Of Measurements".
- 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".

3.2 Summary of Equivalent Test Standards

The following table summarizes the equivalent test standards

| Country | Regulatory | Requirements |
|----------------|---|----------------------|
| United States | Federal Communications Commission (FCC) | USA 47 CFR Part 15 C |

3.3 Deviations Or Exclusions From The Requirements And Standards

There were no deviations or exclusions from the requirements.

4.0 Test Results

4.1 Radiated Emissions Test Results

Transmitter related signals .009 - 30 MHz - FCC 15.225, 15.209 (12/07/01)

The table below shows the detected field strengths as measured from the test sample(s) over the frequency range from 9 kHz to 30 MHz. The emissions were measured at a distance of 30 meters and compared to the maximum permissible FCC limit.

| Freq. [MHz] | Height, Polarity [cm,1/2/3] | Angle [Deg] | Quasi Peak Voltage [dBuV] | Correction Factor [dB/m] | Field Strength [dBuV/m] | FCC Limit @ 30m [dBuV/m] | Δ Limit [dB] | Result |
|-------------|-----------------------------|-------------|---------------------------|--------------------------|-------------------------|--------------------------|--------------|--------------------|
| 13.56 | 100,1** | 067 | 43.2 | -1.22 | 41.98 | 60.00 | -18.0 | Below 15.225 limit |
| 27.12* | 100,1** | 000 | 13.5 | -0.47 | 13.03 | 29.54 | -16.5 | Below 15.209 limit |

*Ambient, noise floor signal **Polarity : 1- Perpendicular to measurement axis

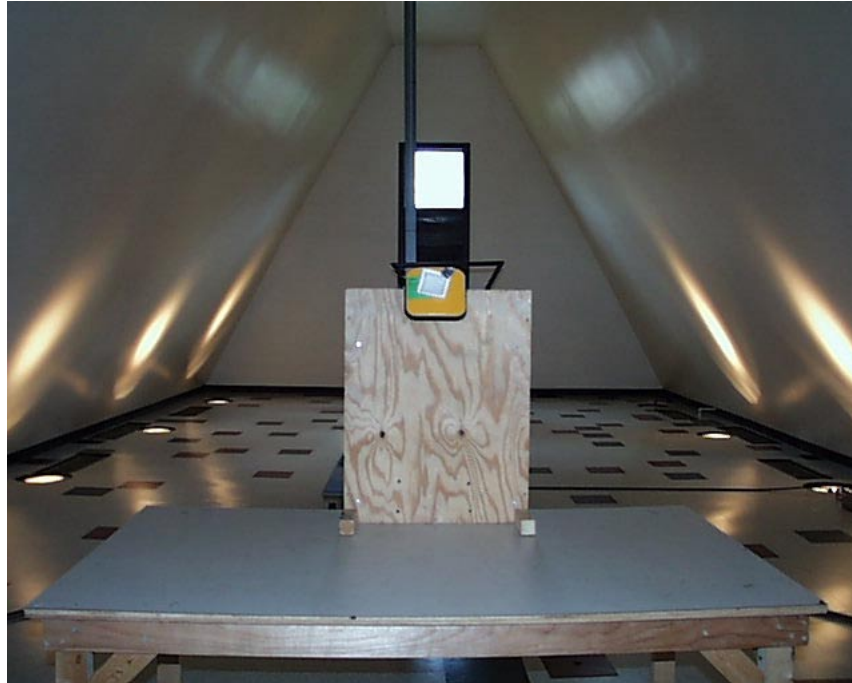
Overall Results: All radiated emissions as recorded at a distance of 30 meters from the Performa Portable Reader are below the 30-meter limit specified by 47 CFR Part 15 Intentional Radiators.

Transmitter related signals 30 to 1000 MHz - FCC 15.209 (12/7/01)

Transmitter related radiated emission signals were measured at a distance of 3 meters from the test sample(s) over the frequency range from 30 MHz to 1000 MHz. The levels were then compared to the maximum permissible FCC limit at 3 meters for spurious signals and harmonics of an intentional radiator.

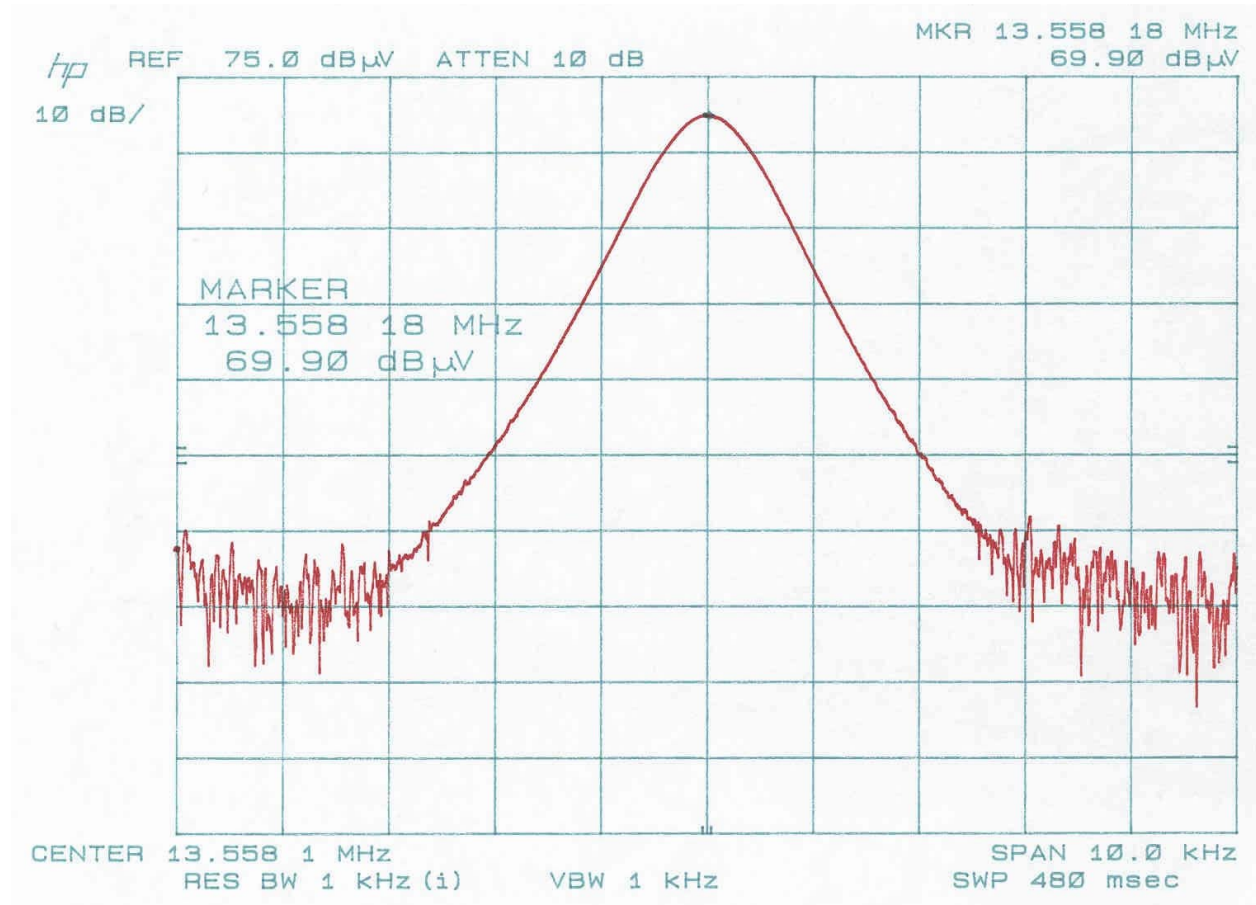
| Freq [MHz] | Height, Polarity [cm,H/V] | Angle [Deg] | Quasi Peak Voltage [dBuV] | Correc-tion Factor [dB/m] | Field Strength [dBuV/m] | FCC Class B Limit @ 3m [dBuV/m] | Delta Limit [dB] | Result |
|------------|---------------------------|-------------|---------------------------|---------------------------|-------------------------|---------------------------------|------------------|-------------|
| 40.693 | 103,V | 177 | 16.9 | 17.3 | 34.2 | 40.00 | -5.8 | Below limit |
| 67.801 | 100,V | 193 | 27.7 | 11.8 | 39.5 | 40.00 | -0.5 | Below limit |
| 81.351 | 121,V | 224 | 24.2 | 10.9 | 35.1 | 40.00 | -4.9 | Below limit |
| 94.904 | 100,V | 176 | 29.2 | 11.8 | 41.0 | 43.54 | -2.5 | Below limit |
| 203.388 | 230,V | 004 | 17.4 | 12.9 | 30.3 | 43.54 | -13.2 | Below limit |
| 569.452 | 123,V | 245 | 10.2 | 22.2 | 32.4 | 46.0 | -13.6 | Below limit |

Overall Results: All radiated emissions as recorded at a distance of 3 meters from the Performa Portable Reader are below the 3-meter limit specified by 47 CFR Part 15 Intentional Radiators.



4.2 Fundamental Spectral Plot (12/7/01)

This picture is the fundamental frequency of 13.56 MHz displayed on a spectrum analyzer using a resolution bandwidth of 1 kHz.



4.3 Frequency Stability Test Results (12/3/01)

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 and input DC voltage.

| Condition | Time[min] | Frequency[Hz] | % Deviation from nominal | Result |
|---------------------------|-----------|---------------|--------------------------|-------------|
| 23°C/12.0 VDC (Nominal) | N/A | 13.558118 | 0.0 | N/A |
| 50°C/12.0 VDC (High Temp) | 0 | 13.558144 | 0.000191767028 | Below limit |
| | 2 | 13.558124 | 0.00004425393 | Below limit |
| | 5 | 13.558119 | 0.000007375655 | Below limit |
| | 10 | 13.558179 | 0.000449914951 | Below limit |
| -20°C/12 VDC (Low Temp) | 0 | 13.558134 | 0.000118010479 | Below limit |
| | 2 | 13.558136 | 0.000132761789 | Below limit |
| | 5 | 13.558140 | 0.000162264409 | Below limit |
| | 10 | 13.558142 | 0.000177015719 | Below limit |

Overall Results: The Performa Portable Reader complied with the requirements of FCC 15.225 for frequency stability by a worst-case deviation of 61 Hz or $100 * 61 / 13558118 = 0.0045 \%$.

Appendix A – Test Procedures

Radiated Emission Test Procedure

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, and accredited by AALA, VCCI, BSMI, 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, 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; perpendicular, parallel and horizontal with respect to the measurement axis. The position of the antenna relative to the ground plane was noted in the reported data.

The correction factor used to convert the measured magnetic field, using the loop antenna, to an equivalent electric field (E).

$$E \text{ (dB V/m)} = AFH \text{ (dB AV}^{-1} \text{ m}^{-1}) + AFE \text{ (dB m}^{-1}) + V_O \text{ (dB V)} + \text{Cable loss}$$

AFH (dB AV⁻¹ m⁻¹): Magnetic-Field Antenna Factor

AFE (dB m⁻¹): Plane-Wave E-field Antenna Factor (51.53 dB)

V_O (dB V): Antenna Output Voltage

Emissions Test Procedure 30 – 1000 MHz

Initial measurements, for the purpose of identifying suspect emissions from the equipment under test, were performed by dividing the test frequency range (30 MHz – 1000 MHz) 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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Meter reading (dBuV)} \\ &\quad + \text{Antenna factor (dB/m)} \\ &\quad + \text{Cable Loss (dB)} \\ \text{Emission (dBuV)} &= \text{Meter reading (dBuV)} + \text{Correction Factor*} \end{aligned}$$

Procedures Frequency Stability Test

The test sample was placed in an environmental chamber at 23°C and allowed to stabilize (minimum 30-minute soak). The nominal operating frequency was measured at this time with a small loop probe connected to a spectrum analyzer.

The test sample was then powered off and allowed to stabilize. The test sample was powered on, using a fully charged batter, and operating frequency measurements was made at nominal temperature.

The temperature was then lowered to -20°C. Frequency measurements were made at 0, 2, 5 and 10 minutes after power on. This procedure was repeated for a high temperature of 50°C. The deviation from nominal temperature operating frequency and the percentage change from nominal was calculated. The frequency variation was compared to the .01% limit of 47 CFR Part 15.225.

Appendix B – Test Equipment List

| <u>Equipment</u> | <u>Model</u> | <u>Manufacturer</u> | <u>ID No.</u> | <u>Last Cal Date</u> |
|---------------------------------------|---------------------|----------------------------|----------------------|---------------------------------|
| QuasiPeak Adapter (10KHz - 1GHz) | 85650A | Hewlett Packard | X717 | 3/30/01 |
| Spectrum Analyzer Display | 85662A | Hewlett Packard | U181 | 3/30/01 |
| Spectrum Analyzer (10KHz – 1.5GHz) | 8566B | Hewlett Packard | X718 | 3/30/01 |
| RF Preselector (20 Hz to 2GHz) | 85685A | Hewlett Packard | Y0312 | 3/30/01 |
| Manual Receiver (9 kHz-30 MHz) | ESH2 | Polarad | U964 | 11/21/01 |
| Manual Receiver (20 MHz -1GHz) | ESV | Polarad | U965 | 7/16/01 |
| Loop Antenna (300 Hz – 100 MHz) | BBH-500/B | ARA | V640 | 6/4/01 |
| Antenna (25MHz to 2GHz) | LFB-2025 | ARA | B-962 | 1/3/01 |
| Temp./Humidity/Alt Chamber | R60100 | Tenney | Y0307 | 6/20/01 |
| Digital Voltmeter | 77 | Fluke | X619 | 8/2/01 |