UNISYS

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

RADIO DISTURBANCE TEST REPORT

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Project No. 337
FCC ID DO4 CSRO7000

CHECKSTATION READER

USA CFR 47 PART 15 REQUIREMENTS

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

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, Checkstation 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 A	General Requirements 30 MHz - 1 GHz	Below Limit
Conducted Emissions	FCC 15.207	General Requirements 450 kHz to 30 MHz	Below Limit
Frequency Stability	FCC 15.225	±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

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 A 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:	Checkstation Reader
Serial Number	None
Manufacturer:	Checkpoint Systems, Inc.
Received by PCTC:	1/8/99

2.2 Description of The Test Item

2.2.1 General

The patron RFID Checkstation provides an individual the means to self check out and self check in library materials. Additionally, the system may report item information and status if there is a program checking out any library items. A typical scenario for a patron to check out a book would be as follows. The patron comes to the REID Checkstation and chooses the "check in" option. The patron identifies himself to the system and confirms his eligibility to carry out a transaction by using his patron identification card which is read by a bar code scanner or a Wiegand card reader. The patron is then led through the transaction process by communication with the system through a touch screen monitor. The patron can check in or check out items by passing them one at a time over a short range interrogator which is located on the RFID Checkstation. The short range interrogator generates a magnetic field which activates and interrogates the tagged item. The interrogated item passes its information to the application server. The application server determines the item status and actions that can be taken via communications with the library circulation system. Then the RFID application server updates the RFID Checkstation which notifies the patron about his transaction.

The RFID Checkstation is composed of a single board computer (SBC), a digital signal processor (DSP) main board, a transceiver board, a printer, a hard drive, an antenna, and, optionally, a Weigand card reader. The touch screen monitor and bar code scanner are external to the Checkstation System Unit.

The transceiver continuously drives the antenna at a carrier frequency of 13.56MHz. The RFID tag is powered by the antenna field. Once the tag has power, it sends out information by amplitude modulating the carrier. The transceiver receives this signal using AM detection, applies gain, and filter the signal. The received signal is then sent over a fiber optic cable to the main board. The main board (DSP board) applies error detection to, and decoding of, this data. The main board sends the processed data to the SBC over an RS-232 serial link. The SBC in turn sends the data to an application server over a 10base-T Ethernet link.

In addition to the RS-232 communications to the main board, the SBC provides RS-232 communications to an external bar code scanner. The bar code scanner is used to enter patron information which is associated with tag data that is scanned in over the Checkstation antenna area. This patron information and associated tag data is sent to the circulation system computer's data base and to the application server.

2.3 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 A limits for digital devices.

2.4 Test Sample Modifications

The test sample complied with the applicable requirements without modifications during the testing.

2.5 Support Equipment

The following devices were installed in the test field to support the operation of the Checkstation Reader, during testing.

Description	Model /P/N	Manufacturer	S/N
Monitor	P284-HL5870A-S	Elo Touch System	MEUE0712401984
Hand-held Scanner	MS951 232	Metrologic	1698070666
AC adapter	CUI stack	#6090	none
Class 2 Power Supply	Detron 11794XA	Check Point	118677

The following devices were installed outside the test field to support the operation of the Checkstation Reader, during testing.

Description	Model /P/N	Manufacturer	S/N
PC	Dell SMS	Diamond Checkpoint	CZ4C4
Monitor	P284-HL5870A-S	Elo Touch System	MEUE0712401989
Ethernet Hub	AT-MR815T	Centrecom	SOBW73401B
Mouse	M-S34	Logitech	LZB74403576
AC Adapter	D7500	Hon Kwang	None

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 at electrical power voltages sufficient to ensure that the measured results were representative of operation of the test sample in the power environments in which it would be installed , as specified by the client.

5.2 Grounding

During EMI testing, earth grounding of the test sample was accomplished through the AC mains input power cord to the PC.

5.3 Operating Mode

During testing, the Checkstation was continuously transmitting and monitoring for the presence of an ID tag. A tag was placed in the vicinity on the Checkstation such that it would continuously detect and transmit data.

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 (1/8/99)

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. Note: signals were measured with antenna off ground plane.

Freq [MHz]	Voltage/ Detector [dBuV]	Corr' Factor [dB/m]	Field Strength [dBuV/m]	FCC Limit @ 30m [dBuV/m]	Delta Limit [dB]	Result
13.56	56.4 QP	-1.2	55.2	80.0	-24.8	Below limit
27.12	22.23 QP	+1.73	23.96	29.5	-5.54	Below limit

- Overall Result: All measured transmitter related radiated emissions below 30 MHz from the Checkstation Reader are below the FCC 15.209 general radiation limits by a margin of 5.54 dB.

Transmitter related signals 30 to 1000 MHz - FCC 15.209

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 limit at 3 meters for spurious 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.

Freq [MHz]	Height, Pol [cm H/V]	Angle [Deg]	Quasi-Peak Voltage [dBuV] Detector	Corr' Factor [dB/m]	Field Strength [dBuV/m]	FCC Limit @ 3m [dBuV/m]	Delta Limit [dB]	Result
257.718	100, V	264	24.4	16.3	40.7	46.0	-5.3	Below limit

- Overall Result: All measured transmitter related radiated emissions above 30 MHz from the Checkstation Reader are below the FCC 15.209 general radiation limits by a margin of 5.3 dB.

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

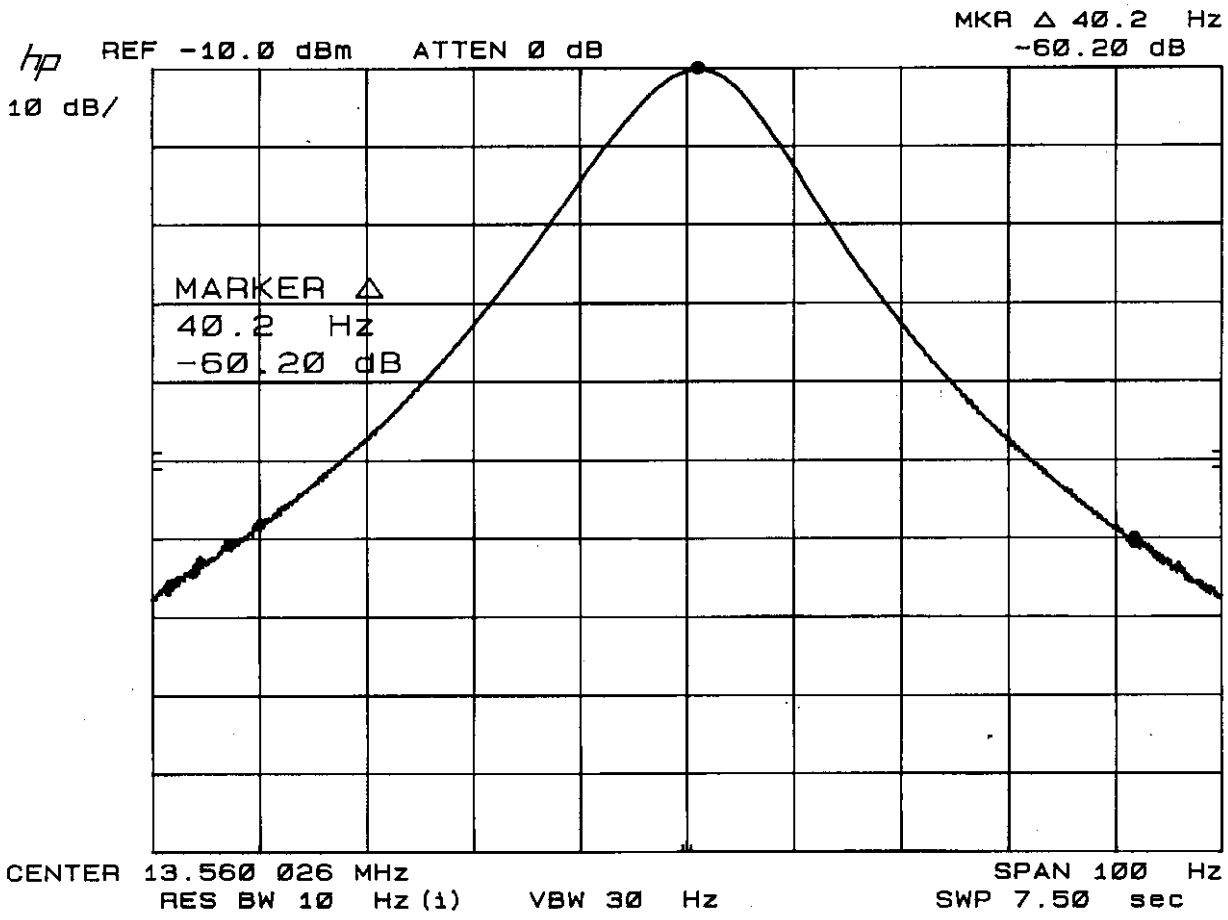
The table below shows the detected field strengths as measured from the test sample(s) over the frequency range from 30 MHz to 1000 MHz, at a distance of 3 meters compared to the maximum permissible FCC Class A limit extrapolated (using limit -20log(3/10) = limit +10.5 dB) to 3 meters. A detailed description of the procedures used in the performance of this test is provided in Appendix 2.

Freq [MHz]	Height, Pol [cm H/V]	Angle [Deg]	Quasi-Peak Voltage [dBuV] Detector	Corr' Factor [dB/m]	Field Strength [dBuV/m]	FCC Class A Limit @ 3m [dBuV/m]	Delta Limit [dB]	Result
39.948	100, V	357	21.3	18.4	39.7	50.5	-10.8	Below limit
47.998	102, V	35	21.4	16.3	37.7	50.5	-12.8	Below limit
49.402	105, V	60	23.7	16.0	39.7	50.5	-10.8	Below limit
49.771	101, V	131	25.5	15.9	41.4	50.5	-9.1	Below limit
240.00	101, V	344	33	15.8	48.8	56.5	-7.7	Below limit
360.023	119, V	89	22.3	19.4	41.7	56.5	-14.8	Below limit

- Overall Result: All measured radiated emissions from the Checkstation Reader are below the FCC Class A limits by a margin of 7.7 dB.

Transmitter fundamental spectral plot

The following plot shows the bandwidth of the transmitter fundamental. The -60 dB bandwidth is approximately 80 Hz. The signal was measured using a small wire-loop probe connected to a spectrum analyzer placed near the test item.



6.1.3 Conducted Emission Test (1/8/99)

The following tables show the conducted emissions measured on the AC power lines of the Checkstation Reader compared to FCC 15.207 general limits. Compliance testing to these limits was performed on the test sample. A detailed description of the procedures used in the performance of this test is provided in Appendix 2.

- Checkstation Reader - Phase Line.

Freq. (MHz)	Quasi Peak Amplitude (dBuV)	NB limit (dBuV)	Delta limit (dBuV)	Result
0.4500	20.0	48.0	-28	Below limit
0.4983	16.0	48.0	-32	Below limit
6.000	-10.0	48.0	-58	Below limit
13.561	34.0	48.0	-14	Below limit
24.000	-9.0	48.0	-57	Below limit
27.120	0.0	48.0	-48	Below limit

- Checkstation Reader - Neutral Line.

Freq. (MHz)	Quasi Peak Amplitude (dBuV)	NB limit (dBuV)	Delta limit (dBuV)	Result
0.4500	23.0	48.0	-25	Below limit
0.4983	16.0	48.0	-32	Below limit
6.000	0.0	48.0	-48	Below limit
13.561	44.0	48.0	-4	Below limit
24.000	-8.0	48.0	-56	Below limit
27.120	3.0	48.0	-45	Below limit

- Overall Results:

  - The Checkstation Reader complied with the requirements of FCC 15.207 by a margin of 4.0 dB.

6.2 Frequency Stability Tests (1/8/99)

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 and input AC voltage. 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/122VAC (Nominal)	N/A	13560033	N/A	N/A
20°C/138 VAC (115% Nom AC)	0	13560032	<<0.01%	Below limit
	2	13560034	<<0.01%	Below limit
	5	13560032	<<0.01%	Below limit
	10	13560032	<<0.01%	Below limit
20°C/102 VAC (85% Nom AC)	0	13560036	<<0.01%	Below limit
	2	13560037	<<0.01%	Below limit
	5	13560035	<<0.01%	Below limit
	10	13560036	<<0.01%	Below limit
50°C/122 VAC (High Temp)	0	13560032	<<0.01%	Below limit
	2	13560030	<<0.01%	Below limit
	5	13560037	<<0.01%	Below limit
	10	13560034	<<0.01%	Below limit
-20°C/122 VAC (Low Temp)	0	13560038	<<0.01%	Below limit
	2	13560040	<<0.01%	Below limit
	5	13560038	<<0.01%	Below limit
	10	13560038	<<0.01%	Below limit

- Overall Results: The Checkstation Reader complied with the requirements of FCC 15.225 for frequency stability by a worst case deviation of 7 Hz or 100*7/13560033 = 5E-5 %.

Appendix 1 - Test Equipment Listing

Radio Disturbance Test Equipment

Equipment	Model	Manufacturer	ID No.	Last Cal Date
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	U181	9/29/98
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

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:

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

A.2.1.2 Conducted Emissions Test, 450 kHz To 30 MHz

Peak amplitude terminal voltage emissions at the power line input to the test sample(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 test sample(s) was operating as described in paragraph 5.3.

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

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

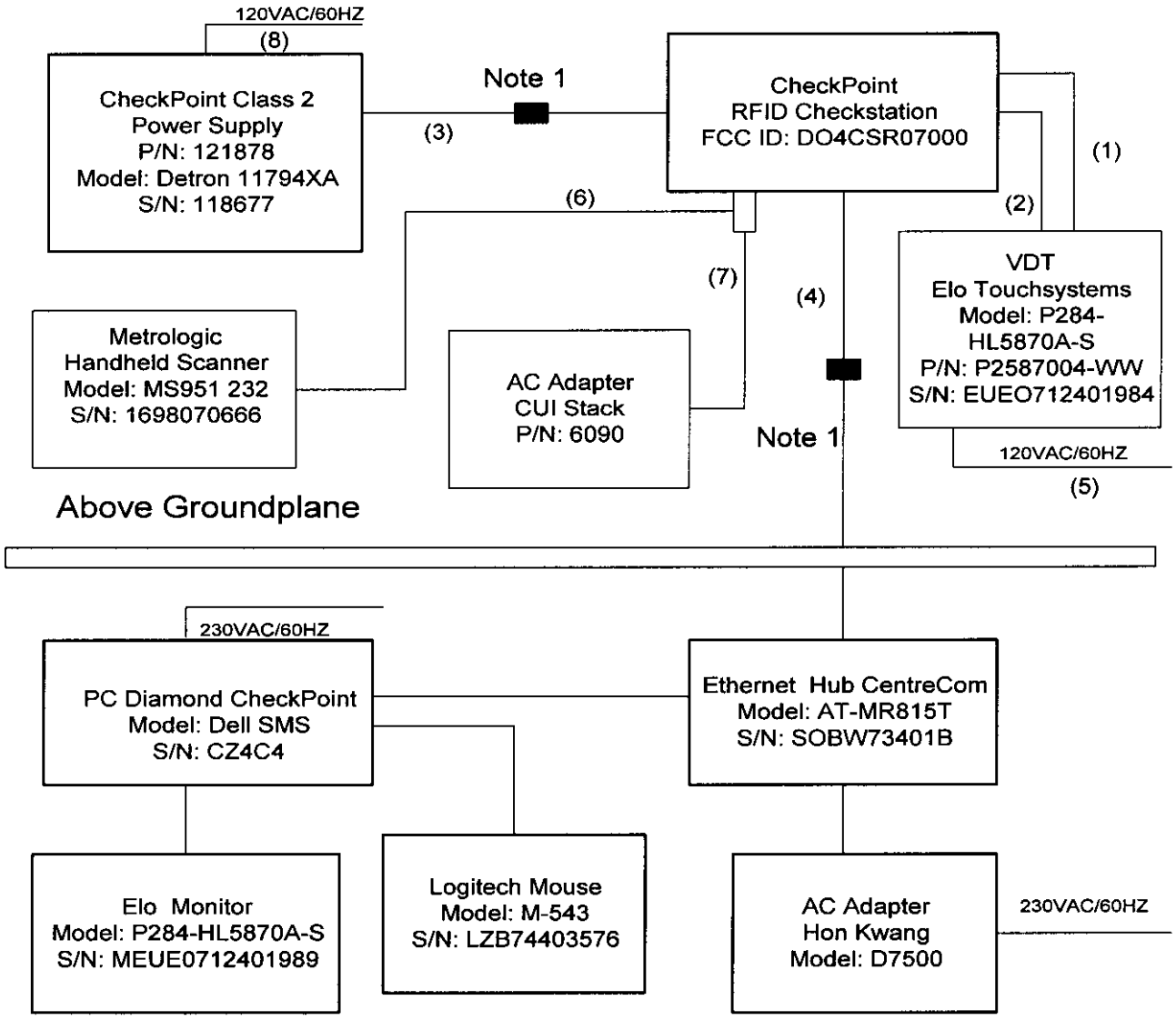
Note: For speed and convenience, a spectrum analyzer employing a peak detector was used as the measuring receiver to sweep through and record the spectrum. As a tool to judge compliance of the emissions, the peak detector sweep is displayed and graphed against the appropriate average limit. This type 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.

A.2.1.3 Frequency Stability Test

The test sample was placed in an environmental chamber at 20°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. With the AC input voltage at 115% of nominal, the test sample was powered on and operating frequency measurements were made at 0, 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



Note 1: cable wrapped around ferrite rod - see photo

1. Elo Touchsystem, P/N 012143, Foil/braid shielded, 6', Serial cable.
2. Video cable, foil/braid shielded, 5'.
3. Checkpoint, braid shielded, 19', 25V DC.
4. LAN cable, unshielded, 25'.
5. AC line cord to VDT, unshielded, 6'.
6. Metrologic scanner cable, P/N 44793, unshielded, 6'.
7. CUI Stack, 5VDC line, unshielded, 6.5'.
8. EUPEN AC Line Cord, P/N IMX04, 6'.

Block Diagram For Checkstation Reader - EMI Testing