

PCTC

Product Compliance Test Center

2476 Swedesford Road, Malvern, PA 19355

ELECTROMAGNETIC INTERFERENCE TEST REPORT

Doc. 20011001R/Project No. 700

TEST STANDARD - USA CFR 47 PART 15

**PERFORMA SWITCH PLATE RFID PROXIMITY READER (AC-125S)
FCC ID: DO4SGRO7000**

**DIAMOND CHECKPOINT DEVELOPMENT GROUP
THOROFARE, NJ**

Test Dates: 5/11/01-10/03/01

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

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

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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 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 Diamond Checkpoint Inc., Performa Switch Plate RFID Proximity Reader (AC-125S), 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, Harmonics	47 CFR Subpart C, 15.209	9 kHz to 1 GHz	Below Max. Permissible Limit
Radiated Emissions Intentional Radiator, Fundamental	47 CFR Subpart C, 15.225	13.553 to 13.567 MHz	Below Max. Permissible Limit
Frequency Stability	47 CFR Subpart C, 15.225	13.56 $\pm$ 0.01%	Within Tolerance

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1.0 Client Information

Client Name: Diamond Checkpoint Development Group
550 Grove Road
Thorofare, NJ 08086

Coordinator: Anthony Mignogna, Ron Salesky

PCTC Personnel: Paul Banker

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 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 Performa Switch Plate RFID Proximity Reader (AC-125S) is an Electronic Access Control System (EAC). The Access Reader utilizes a 13.56 MHz carrier signal that energizes circuitry on an LC resonant tag. The tag then transmits an encoded signal back to the reader that is sent to a processing system that validates the tag and allows access to secure areas or other privileged functions.

2.2 Equipment Sample

2.2.1 Identification

Description:	Performa Switch Plate RFID Proximity Reader
Model:	AC-125S
Serial Number	none
Manufacturer:	Diamond Checkpoint Development Group
Received by PCTC:	11 May 2001
Sample type	Pre-production



Photo 1 – Performa Switch Plate RFID Proximity Reader (AC-125S)

2.2.2 Condition of Received Sample

An evaluation of the Checkpoint, Performa Switch Plate RFID Proximity Reader (AC-125S) was conducted to verify test subject identity and condition and to ensure suitability for testing. No evidence of physical damage was noted. 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

47 CFR, Part 15:

Subpart B, Unintentional Radiators

Subpart C, Intentional Radiators

(Including Clause 15.225: Operation within the band 13.553-13.567 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

There were no deviations or exclusions from the requirements and standards outlined in this report.

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: $22^{\circ}\text{C} \pm 1^{\circ}\text{C}$, Relative Humidity: $50\%\text{RH} \pm 10\%$

5.1.2 Electrical Power

The EUT was operated at DC voltages within the parameters of operation outlined by the manufacturer. The nominal voltage of 12 VDC was used throughout testing.

5.2 Grounding

Ground connection was through the return line of the 12 VDC power source.

5.3 Operating Mode

During testing, the Performa Switch Plate RFID Proximity Reader (AC-125S) was continuously transmitting and monitoring for the presence of a security tag. By design, the EUT is not capable of “standby mode.” A tag was placed in the vicinity of the reader such that it would continuously detect and transmit data.

5.4 Test Configurations

All testing described in this report was performed with the Performa Switch Plate RFID Proximity Reader (AC-125S) in the equipment configuration shown below. The drawing shows the block diagram of the tested configuration used for the EMI tests along with DC power and I/O cable connections. Power and control signal lines were contained in a single cable.

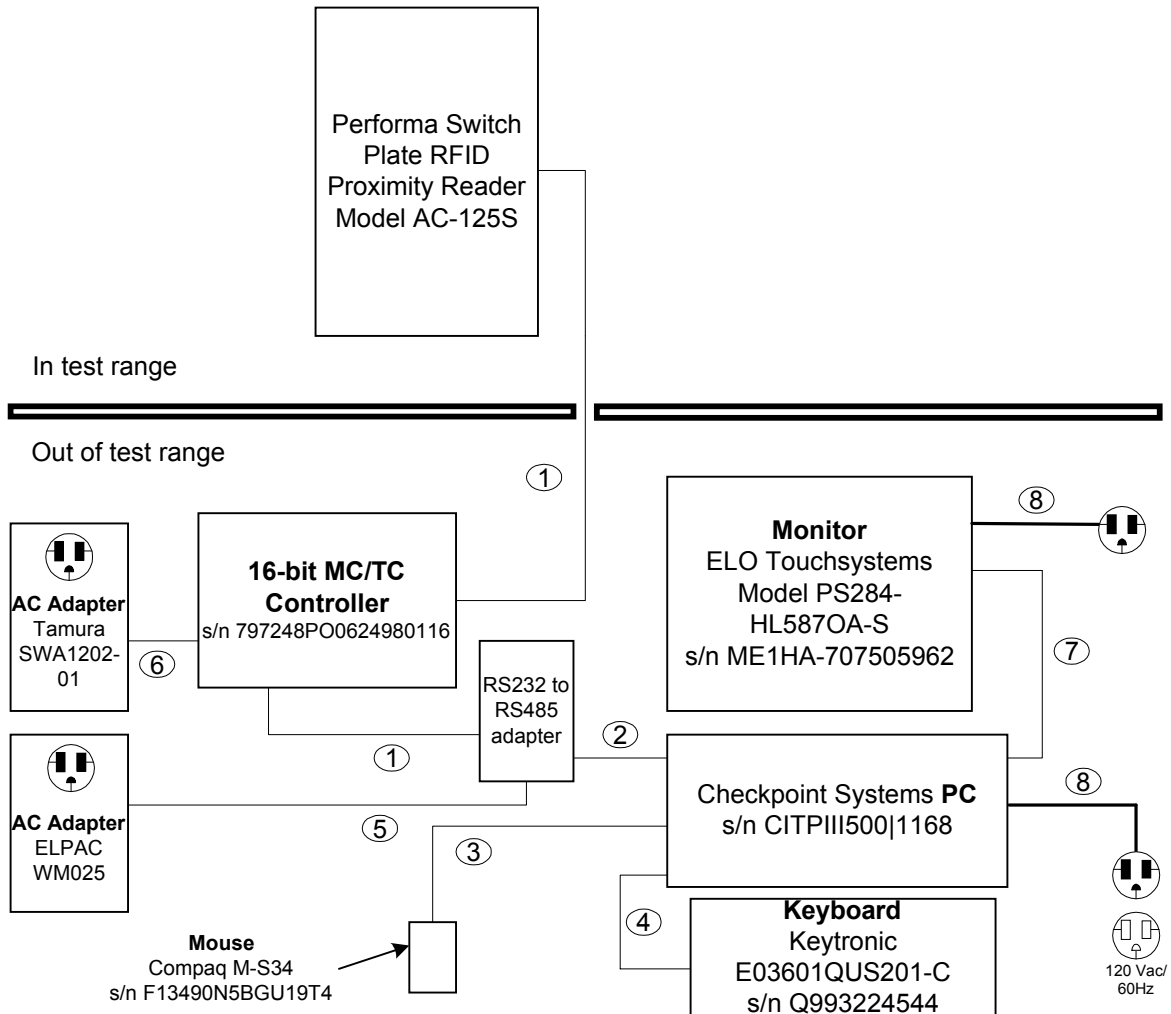


Figure 1 – Block Diagram: Performa Switch Plate RFID Proximity Reader (AC-125S)

#	Description	Mfg	Part Number	Length
1a	Control Cable, shielded	Belden	5504FE	10'
1b	Control Cable, shielded	Belden	5504FE	35'
2	Serial Cable, shielded	-	-	1'
3	Mouse Cable, shielded	Compaq	-	6'
4	Keyboard Cable, shielded	Keytronic	-	6'
5	DC power line, unshielded	ELPAC	-	6'
6	DC power line, unshielded	Tamura	-	6'
7	Video Cable, shielded	-	-	6'
8	AC line cord, unshielded	-	-	7'

Table 1 – Cable List of EUT configuration

5.5 EUT Modifications

There were no modifications made to the EUT to comply with the standards identified in this report.

6.0 Summary of Test Results

6.1 Emission Tests

6.1.1 Radiated Emission Test (8/9/01)

Transmitter related signals .009 - 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 9 kHz to 30 MHz. The emissions were measured at a distance of 30 meters and compared to the maximum permissible FCC limit.

Table 2 – Radiated Emissions Data – 9 kHz to 30 MHz

Freq. [MHz]	Height, Polarity [cm,H/V]	Angle [Deg]	Quasi Peak Voltage [dBuV]	Correc- tion Factor [dB/m]	Field Strength [dBuV/m]	FCC Limit @ 30m [dBuV/m]	Delta Limit [dB]	Result
13.56	100,V	058	47.5	-1.22	46.28	80.00	-32.5	Below 15.225 limit
27.12*	100,V	000	14.0	-0.47	13.53	29.54	-16.0	Below 15.209 limit

*Ambient noise floor signal

Overall Result: All measured transmitter related radiated emissions below 30 MHz from the Performa Switch Plate RFID Proximity Reader (AC-125S) are below the FCC limits by a margin of 16.0 dB.

Transmitter related signals 30 to 1000 MHz - FCC 15.209

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.

Table 3 – Radiated Emissions Data – 30MHz to 1 GHz -Transmitter Harmonics

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
108.506	100,V	087	13.4	12.9	26.3	43.5	-17.2	Below limit
143.180	328,V	009	11.5	12.0	23.5	43.5	-20.0	Below limit
176.270	100,V	236	13.6	11.8	25.4	43.5	-18.1	Below limit
189.830	100,V	209	12.7	12.4	25.1	43.5	-18.4	Below limit
352.562	240,H	046	9.5	18.6	28.1	46.0	-17.9	Below limit
663.176	382,V	311	4.9	24.0	28.9	46.0	-17.1	Below limit

- Overall Results: The Performa Switch Plate RFID Proximity Reader (AC-125S) complied with the requirements of 47 CFR Part 15C for Intentional Radiators by a margin of at least 17.1 dB.


Photo 2 – Performa Switch Plate Radiated Emissions Test Setup - Front

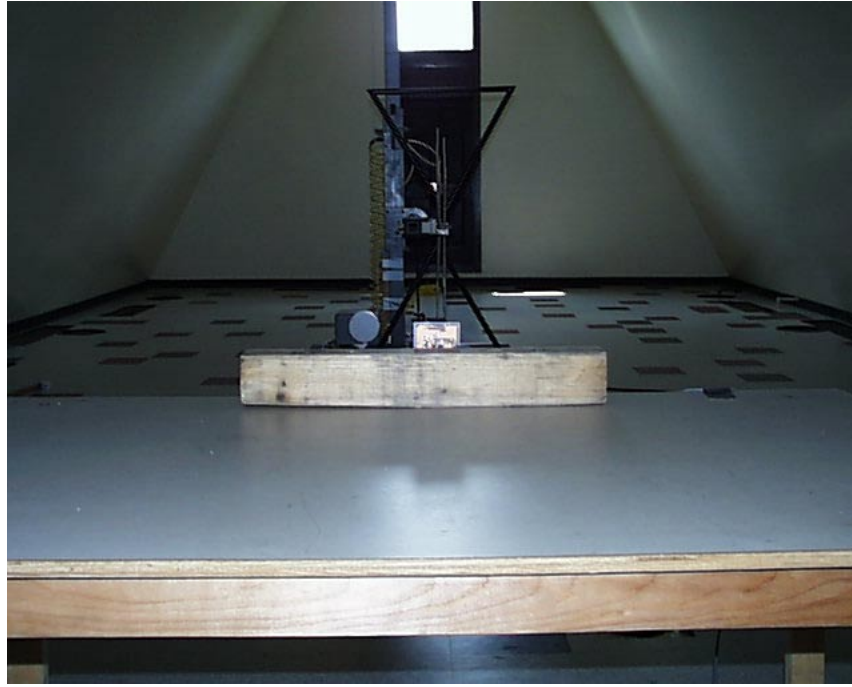


Photo 3 -- Performa Switch Plate Radiated Emissions Test Setup -- Rear

6.1.2 Fundamental Spectral Plot (8/9/2001)

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

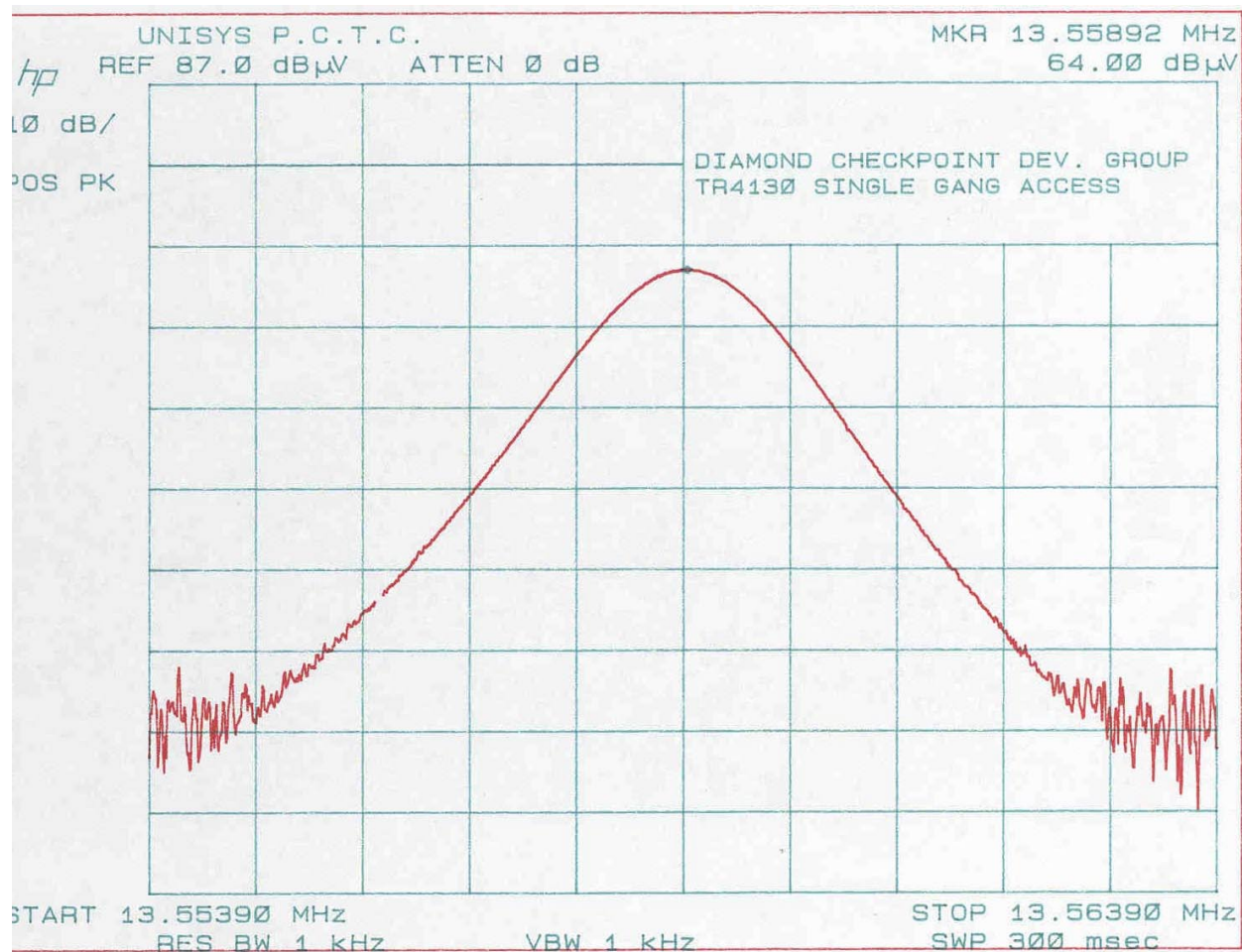


Photo 4 – Bandwidth Plot of the Performa Switch Plate RFID Proximity Reader (AC-125S)

6.1.3 Frequency Stability Test Results (10/3/01)

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.

Table 4 – Temperature Stability Table

Condition	Time[min]	Frequency[Hz]	% Deviation from nominal	Result
20°C/12 VDC (Nominal)	N/A	13.558863	0.0	N/A
20°C/13.8 VDC (115% Nom DC)	0	13.558864	0.000007375249	Below limit
	2	13.558862	0.00000737525	Below limit
	5	13.558861	0.000014750502	Below limit
	10	13.558861	0.000014750502	Below limit
20°C/10.2 VDC (85% Nom DC)	0	13.558860	0.000022125754	Below limit
	2	13.558861	0.000014750502	Below limit
	5	13.558865	0.000014750497	Below limit
	10	13.558865	0.000014750497	Below limit
50°C/12 VDC (High Temp)	0	13.558743	0.000885037794	Below limit
	2	13.558735	0.000944040871	Below limit
	5	13.558730	0.000980917829	Below limit
	10	13.558726	0.001010419416	Below limit
-20°C/12 VDC (Low Temp)	0	13.559019	0.001150525713	Below limit
	2	13.559022	0.001172650948	Below limit
	5	13.559027	0.001209526318	Below limit
	10	13.559025	0.001194776173	Below limit

Overall Results: The Performa Switch Plate RFID Proximity Reader (AC-125S) complied with the requirements of FCC 15.225 for frequency stability by a worst case deviation of 164 Hz or $100 \times 164 / 13558863 = 0.00121\%$.

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>
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	11/27/00
Manual Receiver (20 MHz -1GHz)	ESV	Polarad	U965	7/16/01
LISN	MN2053	Chase Electric Limited	U776	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
DC Power Supply (0-20 V)	LH121A	Lambda	M973	N/R
Digital Voltmeter	77	Fluke	X619	8/2/01

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

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

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

Procedures 9kHz to 30 MHz

Testing below 30 MHz was performed with the EUT configured on the test site as above. An H-field measuring antenna was placed at a distance of 30 meters from the EUT, 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. The position of the antenna relative to the ground plane was noted in the reported data.

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 re-measured 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:

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

Procedures 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 extremes.