TEST REPORT

Report Number: 3113388MIN-001
Project Number: 3113388

January 9, 2007

Evaluation of the
Scan Station with RFID Antenna Pad
FCC ID: PB4DGSCN100

to
FCC Part 2
FCC Part 15, Subpart C, Section 15.225

For
Imation

Test Performed by:
Intertek
7250 Hudson Blvd. Suite 100
Oakdale, MN 55128

Test Authorized by:
Imation
1 Imation Place
304-2A-30
Oakdale, MN 55128

Prepared by: _____ Date: January 9, 2007
Uri Spector

Reviewed by: _____ Date: January 9, 2007
Norman Shpilsher

CONTENTS

1.0 GENERAL DESCRIPTION

1.1 Related Submittals Grants

This is single application of the *Scan Station* (model: DGSCN-100 s/n: 003) *with RFID Antenna Pad* (model DGANT-100 s/n: 002) for Certification under Part 15 Subpart C.
There are no other simultaneous applications.

1.2 Product Description

The *Scan Station with RFID Antenna Pad* is operating at 13.56 MHz.
The *RF ID* Transmitter is incorporated in the Scan Station with RFID Antenna Pad.
The intended use of the *System* is to generate and transmit a RF signal from the Antenna to the RF ID Tag; the same antenna is used to receive RF signal from the tag.
The *Scan Station with RFID Antenna Pad* is powered at 120 VAC, 60 Hz.

The *RFID Scan Station t*ransmitter is connected to the RFID Antenna pad via 90cm Antenna Cable with SMA connector.

Sample Submitted: January 8, 2007
Test Work Started: January 8, 2007
Test Work Completed: January 9, 2007

Emission measurements were performed according to the procedures in ANSI C63.4-2003. All field strength radiated emissions measurements were performed in the semi-anechoic chamber, and for each scan, the procedure for maximizing emissions in Appendices D and E were followed. All field strength radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4 Test Facility

The test site facility used to collect the radiated and conducted measurement data is located at 7250 Hudson Blvd., Suite 100, Oakdale, Minnesota. This test facility has been fully described in a report dated on December 2005 submitted to FCC. Please reference the site registration number: 90706, dated December 6, 2005.

2.0 SYSTEM TEST CONFIGURATION

2.1 Justification

To demonstrate the *Scan Station with RFID Antenna Pad* compliance the system was tested with 90cm antenna cable and RS232 communication cable, the Field Strength of Fundamental frequency and Out of Band Spurious Emissions were tested for 90cm antenna cable and RS232 (with Ferrite) cable.
The Conducted Emissions test was performed with terminated antenna output.

2.2 EUT Setup

For simplicity of testing, the transmitter was set to transmit continuously under the exercising software.

2.3 EUT Exercising Software

ISOStart, ID ISC.LR200 test software.

2.4 Special Accessories

There are no special accessories necessary for compliance of these products.

2.5 Equipment Modification

No modifications were installed during the testing.

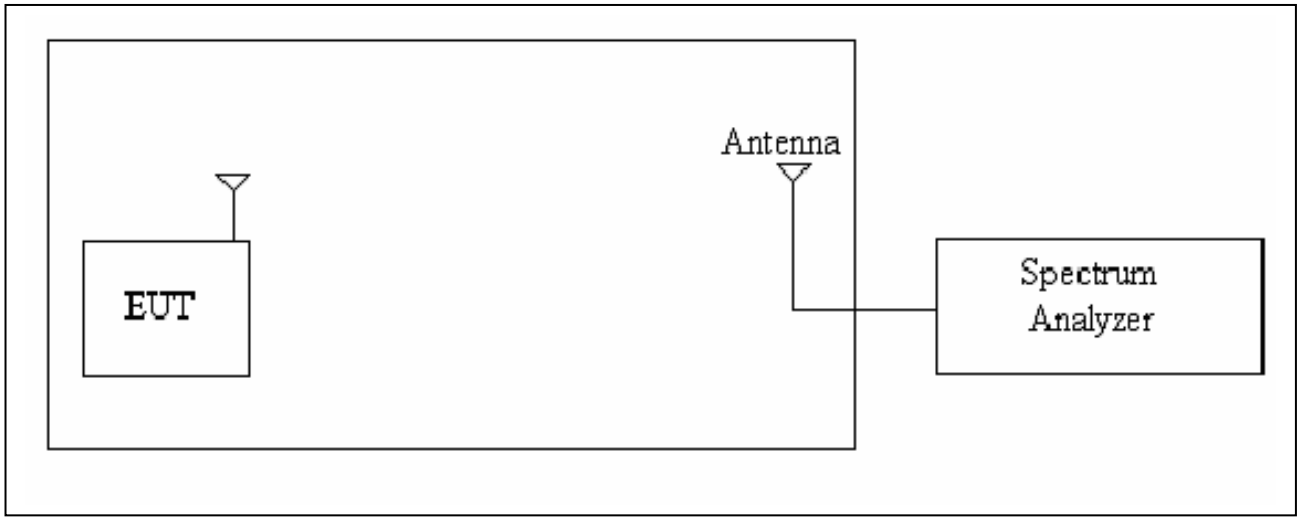
2.6 Support Equipment List and Description

DELL Laptop computer model: E610

2.7 Test Configuration Block Diagrams

The EUT was setup as tabletop equipment.
Measurements below 30MHz were performed at 10-m measurement distance with Loop Antenna.
Measurements from 30MHz to 1GHz were performed at 3-m measurement distance with Bicono-Log Antenna.
The EUT was powered at 120VAC/60Hz.

Field Strength Measurements



3.0 TEST RESULTS

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs, data tables and graphical representations of the emissions are included.

The EUT is intended for operation under the requirements of Part 15 Subpart C. Specific test requirements include the following:

47 CFR 15.225(a)(b)(c)	Field Strength of Fundamental
47 CFR 15.225(d), 15.209	Out of Band Spurious Emissions
47 CFR 15.225(d), 15.209	Field Strength of Spurious Emissions
47 CFR 15.225(e)	Frequency Tolerance
47 CFR 15.215	Bandwidth of the Emission
47 CFR 15.207	Conducted Emissions

3.1 Field Strength of Radiated Emissions, FCC 15.225(a)(b)(c), 15.209

Field Strength of Fundamental and Harmonics Emissions measurements were made at Fundamental frequency of 13. 56 MHz.

FCC Part 15.225 limits at 30m are:

15848µV/m, or 84.0dBµV/m within the band 13.553-13.567MHz
334µV/m, or 50.5dBµV/m within the bands 13.410-13.553MHz and 13.567-13.710MHz
106µV/m, or 40.5dBµV/m within the bands 13.110-13.410MHz and 13.710-14.010MHz

The maximum emissions were measured at 13.56MHz with margin 3.3dB below the limits.

The Table 3-1-1 below shows the Field Strength of Fundamental Radiation.

Radiated Emissions at Fundamental **Date:** 1/8/2007

Company:	Imation
Model:	Scan Station with RFID Antenna Pad
Test Engineer:	Uri Spector
Special Info:	Continuous transmission
Standard:	FCC Part 15.225
Test Site:	Open Area Test Site, 10m measurement distance
Note:	Measurement distance 10m with Loop antenna SAS 200/562B Distance Factor is 40dB per decade from 490kHz to 30MHz.

Table # 3-1-1

Frequency MHz	Reading dBµV	E Antenna Factor dB/m	Pre-Amp Gain (dB)	Net at 10m. dBµA/m	Distance Factor (dB)	Limit dBµV/m	Margin dB	Antenna pos.
13.560	88.2	6.9	0.0	95.1	19.1	84.0	-8.0	Front
13.560	92.9	6.9	0.0	99.8	19.1	84.0	-3.3	Side

3.2 Out of Band Spurious Emissions, FCC 15.225(d), 15.209

To demonstrate the EUT compliance with the Out of band spurious emissions, measurements were made for frequencies 13.410-13.553MHz, 13.567-13.710MHz, 13.110-13.410MHz and 13.710-14.010MHz, 15.553 and 15.567MHz

The EUT operating frequency is 13.560MHz

The maximum emissions were measured with margin 9.9dB.

The Table 3-2-1 below shows the Out of Band Spurious Emissions.

Table # 3-2-1

Frequency MHz	Reading dBµV	E Antenna Factor dB/m	Pre-Amp Gain (dB)	Net at 10m. dBµA/m	Distance Factor (dB)	Limit dBµV/m	Margin dB	Antenna pos.
13.110	4.5	8.0		12.5	19.1	29.5	-36.1	Front
13.110	9.3	8.0		17.3	19.1	29.5	-31.3	Side
13.410	18.2	7.3		25.5	19.1	40.5	-34.1	Front
13.410	22.2	7.3		29.5	19.1	40.5	-30.1	Side
13.553	34.2	7.0		41.2	19.1	50.5	-28.4	Front
13.553	40.6	7.0		47.6	19.1	50.5	-22.0	Side
13.567	37.5	6.9		44.4	19.1	50.5	-25.2	Front
13.567	42.8	6.9		49.7	19.1	50.5	-19.9	Side
13.710	17.7	6.6		24.3	19.1	40.5	-35.3	Front
13.710	22.0	6.6		28.6	19.1	40.5	-31.0	Side
14.010	6.3	5.8		12.1	19.1	29.5	-36.5	Front
14.010	13.6	5.8		19.4	19.1	29.5	-29.2	Side

3.3 Field Strength of Spurious Emissions, FCC 15.205, 15.209

Field Strength of Spurious Emissions measurements were made in frequency range from the EUT operating frequency of 13.560MHz up to 1000MHz.

FCC Part 15.209 limits are:

1.705-30MHz at 30m is 30µV/m, or 29.5dBµV/m
30-88MHz at 3m is 100µV/m, or 40.0dBµV/m
88-216MHz at 3m is 150µV/m, or 43.5dBµV/m
216-960MHz at 3m is 200µV/m, or 46.0dBµV/m
above 960MHz at 3m is 500µV/m, or 54.0dBµV/m

The maximum emissions were measured with margin 5.3dB below limits.

The Tables 3-3-1 show the Spurious Emissions

Note: No transmitting spurious emissions within restricted bands of operation according 15.205 were detected in frequency range 30-1000MHz

Spurious Radiated Emissions **Date:** 1/8/2007

Company:	Imation
Model:	Scan Station with RFID Antenna Pad
Test Engineer:	Uri Spector
Special Info:	Continuous transmission
	Fundamental Opearting Frequency 13.56MHz
Standard:	FCC Part 15.209
Test Site:	Open Area Test Site, 10m measurement distance
Note:	Measurement distance 10m with Loop antenna SAS 200/562B
	Distance Factor is 40dB per decade from 490kHz to 30MHz.

Table # 3-3-1

Frequency MHz	Reading dBµV	E Antenna Factor dB/m	Pre-Amp Gain (dB)	Net at 10m. dBµA/m	Distance Factor (dB)	Limit dBµV/m	Margin dB	Antenna pos.
27.129	46.4	14.7	28.4	32.7	19.1	29.5	-15.9	Front
27.107	58.3	14.7	28.4	44.6	19.1	29.5	-4.0	Side

3.4 Frequency Tolerance, FCC 15.225(e)

Frequency Stability with variation of ambient temperature was measured from –20 degrees C to +50 degrees C at frequency 13.56 MHz and rated power input 120VAC/60Hz.

Frequency Stability with variation of primary supply voltage was measured at 85% (102V) and 115% (138V) of rated AC Power Supply input voltage of 120V at frequency 13.56 MHz.

The Table 3-4-1 below shows the frequency stability vs. temperature ambient and supply voltage.

Frequency Stability **Date:** 1/8/2007
Company: Imation
Model: Scan Station with RFID antenna Pad
Special Info: Enviromental Chamber (Frequency Stability testing)
Test Engineer: Uri Spector
Standard: FCC 15.225(e)

Table # 3-4-1

Temperature Degree C	Output Frequency MHz	Frequency Stability Hz	Max. Deviation + /- 0.01% Hz	Test Result
-20	13.56	67	1356	Pass
-10	13.56	40	1356	Pass
0	13.56	21	1356	Pass
10	13.56	11	1356	Pass
20	13.56	0	1356	Pass
30	13.56	9	1356	Pass
40	13.56	15	1356	Pass
50	13.56	20	1356	Pass
55	13.56	25	1356	Pass
Input Power AC Voltage V	Output Frequency MHz	Frequency Stability Hz	Freq. Tolerance + /- 0.01% Hz	Test Result
102	13.56	0	1356	Pass
110	13.56	0	1356	Pass
120	13.56	0	1356	Pass
130	13.56	0	1356	Pass
138	13.56	0	1356	Pass

3.5 Bandwidth of Emissions, FCC 15.215

Bandwidth of Emissions measurements was made for the Fundamental frequency of 13.56MHz.

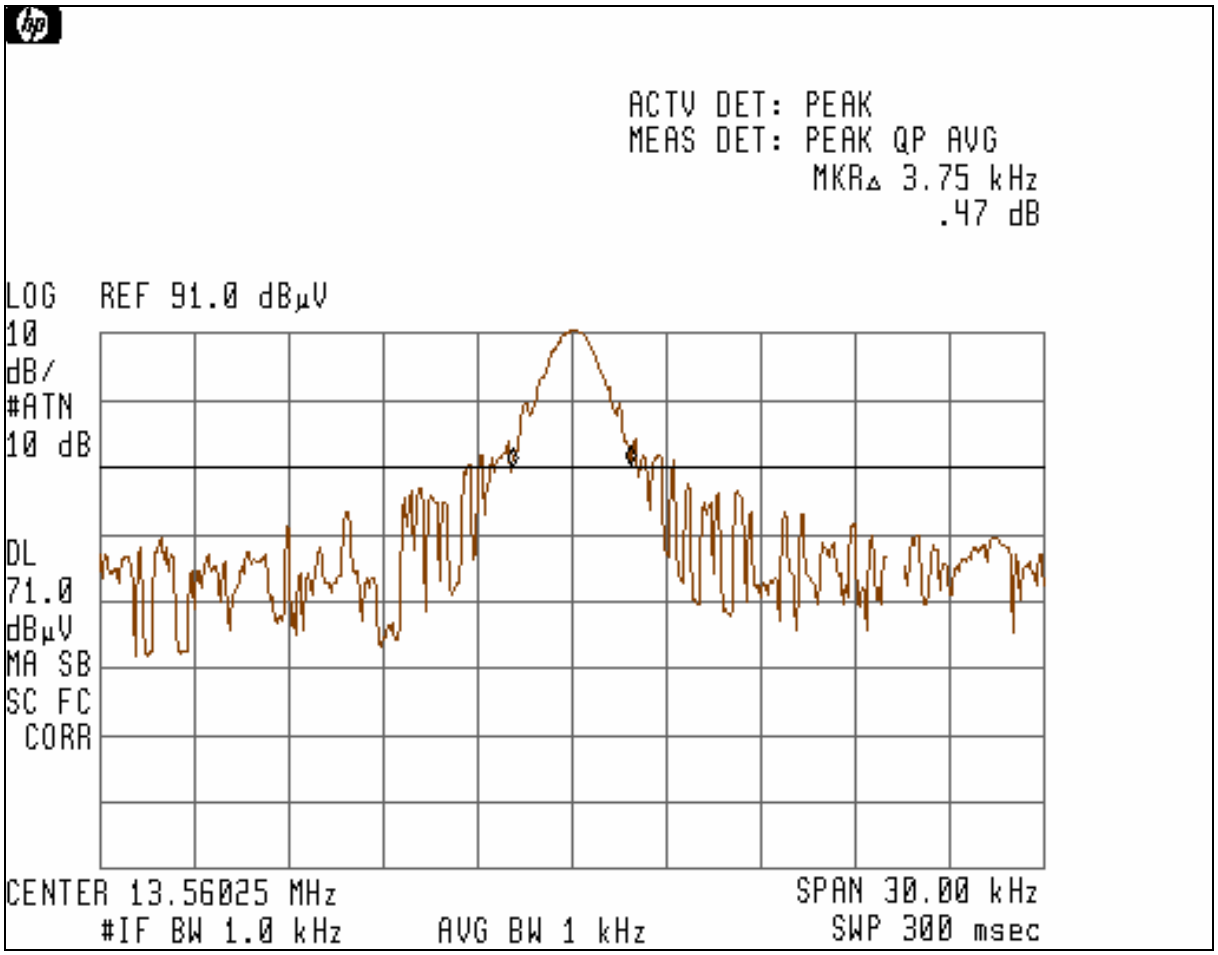
The Specified by FCC Part 15.225 frequency band is 13.553-13.567MHz, or 13560±7kHz.

20dB Bandwidth of Emissions at fundamental frequency was measured at 3.75kHz.

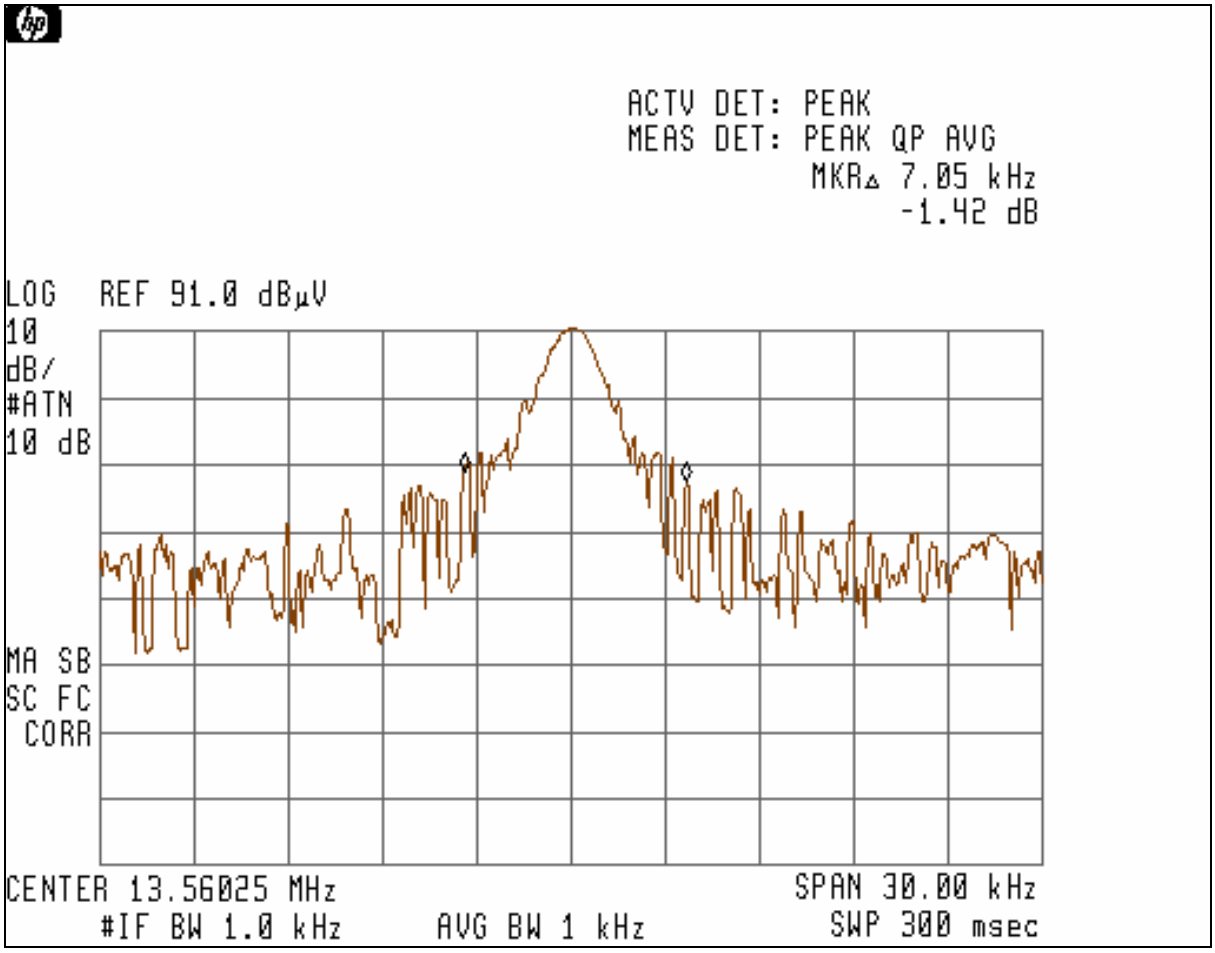
99% Bandwidth of Emissions at fundamental frequency was measured at 7.05kHz.

The Graphs 3-5-1 and 3-5-2 show the Bandwidth of Emissions.

Graph # 3-5-1
20dB Bandwidth



Graph # 3-5-2
99% Bandwidth



3.6 Line Conducted Emissions, FCC 15.207

Conducted Emissions testing was performed in frequency range from 150kHz to 30MHz.
The Conducted Emissions test was performed with terminated antenna output.

The maximum emissions were measured with margin 7.1dB below limits.

The Table # 3-6-1and Graph # 3-6-1 shows the Conducted Emissions.

Conducted Emissions from 150kHz to 30MHz **Date:** 01-05-2007

Company: Imation
Model: Scan Station with Antenna Pad
Test Engineer: Simon Khazon
Standard: FCC Part 15.207
Note: The table shows the worst case conducted emissions
All measurements were taken using a CISPR Quasi-peak detector

Table # 3-6-1

Line 1

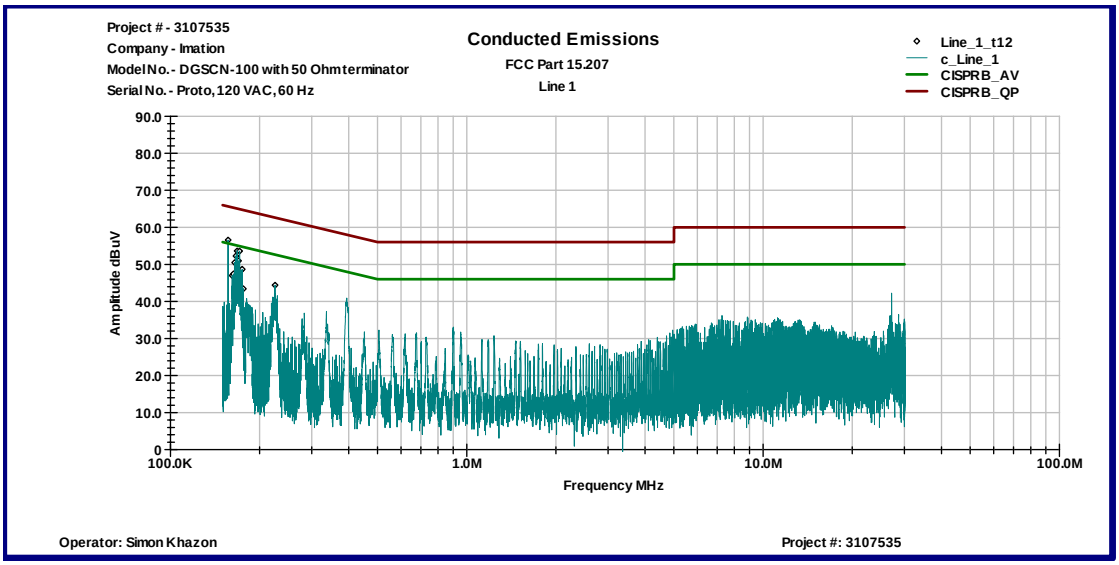
Frequency	QP dBµV	AVG dBµV	QP Limit dBµV	AVG Limit dBµV	QP Margin dB	AVG Margin dB
157.43 KHz	40.1	22.5	65.6	55.6	-25.6	-33.1
160.67 KHz	41.7	31.2	65.5	55.5	-23.8	-24.3
161.78 KHz	41.1	34.8	65.4	55.4	-24.3	-20.6
163.64 KHz	45.8	40.3	65.3	55.3	-19.5	-15.0
164.28 KHz	47.5	42.1	65.2	55.2	-17.7	-13.1
166.73 KHz	51.4	46.5	65.1	55.1	-13.8	-8.6
168.53 KHz	52.3	47.5	65.0	55.0	-12.7	-7.5
169.0 KHz	52.3	47.5	65.0	55.0	-12.8	-7.5
171.09 KHz	50.4	45.7	64.9	54.9	-14.5	-9.2
223.05 KHz	42.5	38.9	62.7	52.7	-20.2	-13.8

Line 2

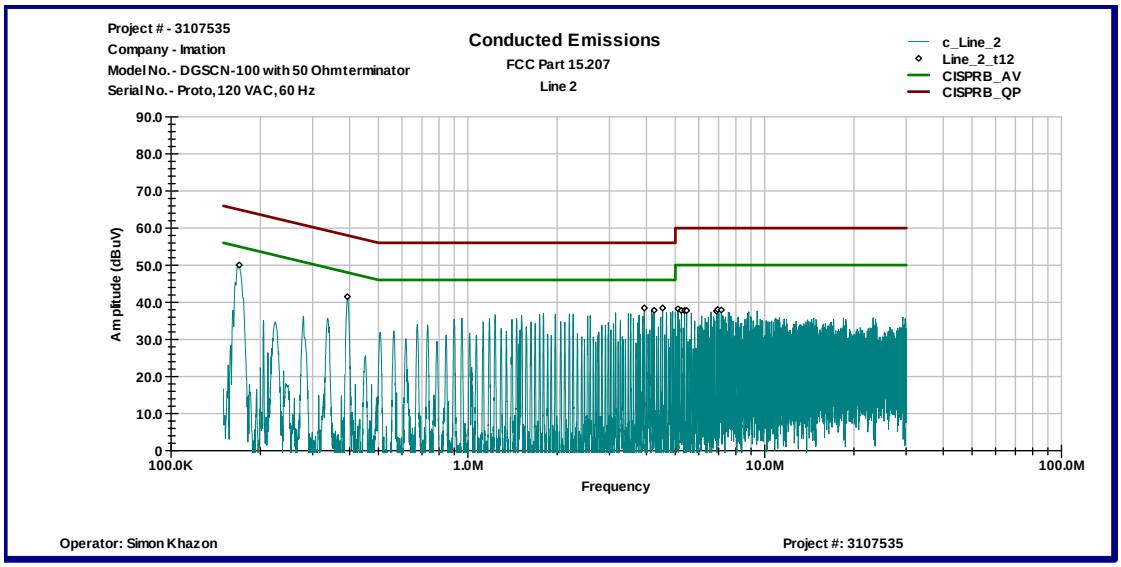
Frequency	QP dBµV	AVG dBµV	QP Limit dBµV	AVG Limit dBµV	QP Margin dB	AVG Margin dB
166.65 KHz	50.5	45.6	65.1	55.1	-14.7	-9.5
395.09 KHz	41.5	40.9	58.0	48.0	-16.5	-7.1
3.8817 MHz	37.9	34.0	56.0	56.0	-18.1	-22.0
4.2354 MHz	16.8	7.7	56.0	56.0	-39.2	-48.4
4.5618 MHz	33.5	25.1	56.0	56.0	-22.5	-30.9
5.2243 MHz	34.7	26.5	60.0	50.0	-25.3	-23.5
5.3481 MHz	34.8	26.9	60.0	50.0	-25.2	-23.1
5.4171 MHz	16.3	7.8	60.0	50.0	-43.7	-42.2
7.2451 MHz	36.1	25.3	60.0	50.0	-23.9	-24.7

Graph # 5-6-1
Conducted Emissions from 150kHz to 30MHz

Line 1



Line 2



3.6 Test Procedure

Field Strength Measurements

The EUT was placed on a non-conductive table 0.8m above the ground plane. The table was centered on a motorized turntable, which allows 360-degree rotation. The measurement antenna was positioned at 3m distance. The Bicono-Log antenna was used in frequency range from 30MHz to 1GHz. The radiated emissions were maximized by configuring the EUT, by rotating the EUT, by changing antenna polarization, and by changing antenna height from 1 to 4m.
In frequency range below 30MHz the Loop antenna was used at 10m measurement distance with antenna heights of 1m and antenna loop and side faced to the EUT.
Method of the direct Field Strength Calculation is shown in Section 3.4.

Frequency Tolerance

The EUT was placed in an environmental test chamber and powered such that control element received normal voltage and the transmitter provided maximum RF output. The Chamber was programmed to cool from room temperature to minus 20 degrees C and then step in 10-degree increments to plus 55 degrees C.
For Frequency Stability testing with variation of primary supply voltage the EUT power supply was powered at rated supply voltage at 120VAC/60Hz and then at 102VAC/60Hz and 138VAC/60Hz

Conducted Emissions

For conducted emissions testing, the equipment is moved to an insulating platform over the ground plane, and the EUT is powered from a LISN. Both sides of the AC line are measured and the results are compared to the applicable limits. Measurements are taken using CISPR quasi-peak and average detectors when the peak readings approach or exceed the average limit. Only quasi-peak readings are taken when the emissions from the EUT meet the average limit as measured with the quasi-peak detector. Only peak readings might be taken when the emissions from the EUT meet the average limit as measured with the peak detector.

3.7 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.
The basic equation with a sample calculation is as follows:
FS = RA + AF + CF - AG

Where: FS = Field Strength in dB(µV/m)
RA = Receiver Amplitude in dB(µV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB(m^{-1})
AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB(µV) is obtained. The antenna factor of 7.4 dB(m^{-1}) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dB is subtracted giving field strength of 41.1 dB(µV/m).

RA = 48.1 dB(µV)
AF = 7.4 dB(m^{-1})
CF = 1.6 dB
AG = 16.0 dB
FS = RA + AF + CF - AG
FS = 48.1 + 7.4 + 1.6 – 16.0
FS = 41.1 dB(µV/m)

In the tables the Cable correction factors are included to the Antenna Factors.

3.8 Measurement Uncertainty

The expanded uncertainty (k = 2) for radiated emissions from 30 to 1000 MHz has been determined to be:
±4 dB at 10m ±5.4 dB at 3m

The expanded uncertainty (k = 2) for emissions from 150 kHz to 30 MHz has been determined to be:
±2.6 dB

Tested by:

Uri Spector
EMC Project Engineer
Intertek ETL SEMKO

Signature

Date: January 9, 2007

4.0 TEST EQUIPMENT

Receivers/Spectrum Analyzers and Test Software

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
HP85462A Receiver RF Section	3325A00106	04/06	04/07	
HP85460A RF Filter Section	3330A00109	04/06	04/07	
HP85462A Receiver RF Section	3549A00306	02/06	02/07	X
HP85460A RF Filter Section	3448A00276	02/06	02/07	X
Rohde & Schwarz FSP 40 Spectrum Analyzer	100024	07/06	07/07	
Rohde & Schwarz ESCI Spectrum Analyzer	100358	04/06	04/07	X
Advantest R3271A Spectrum Analyzer	55050084	10/06	10/07	
Agilent E7402A Spectrum Analyzer	MY44212200	10/06	10/07	
TILE! Instrument Control System	Ver. 3.4 K.20	N/A	N/A	X

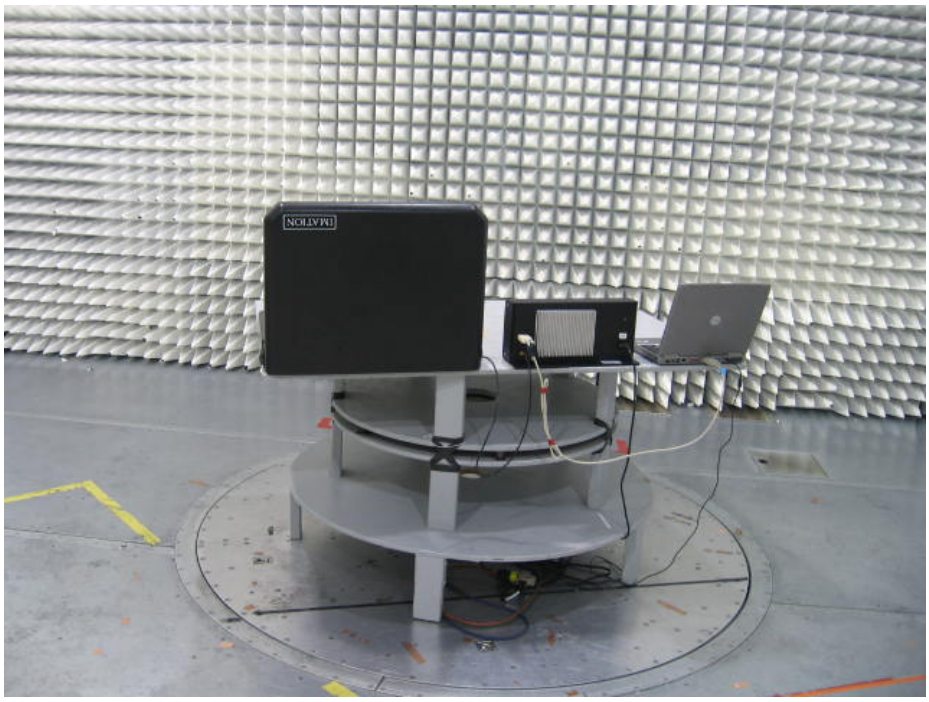
Antennas

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
Schaffner-Chase Bicono-Log Antenna	2468	01/06	01/07	
Schaffner-Chase Bicono-Log Antenna	2630	08/06	08/07	X
EMCO Horn Antenna 3115	9507-4513	01/06	01/07	
A.H. System Loop Antenna SAS-200/562	215	05/06	05/07	X
MITEQ AMF-5D Pre-Amplifier	1122951	02/06	02/07	
HP 8447F Pre-Amplifier	3113A04974	02/06	02/07	X

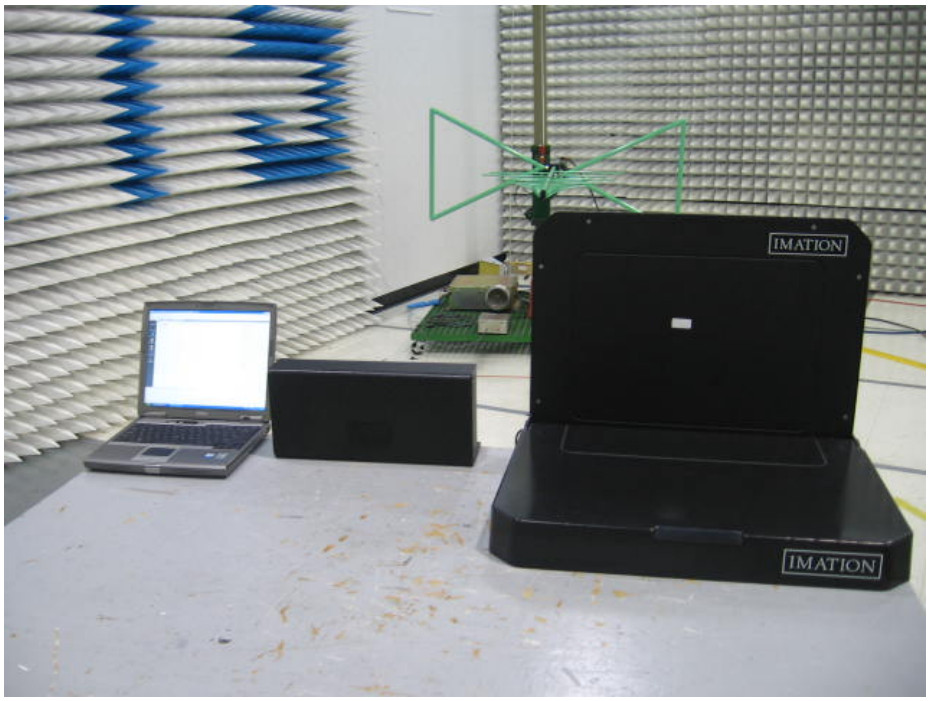
Artificial Mains Networks/Absorbing Clamps

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
FCC LISN-2	316	05/06	05/07	X
FCC-LISN-50-25-2	2014	09/05	10/07	

EXHIBIT 1
CONFIGURATION PHOTOS



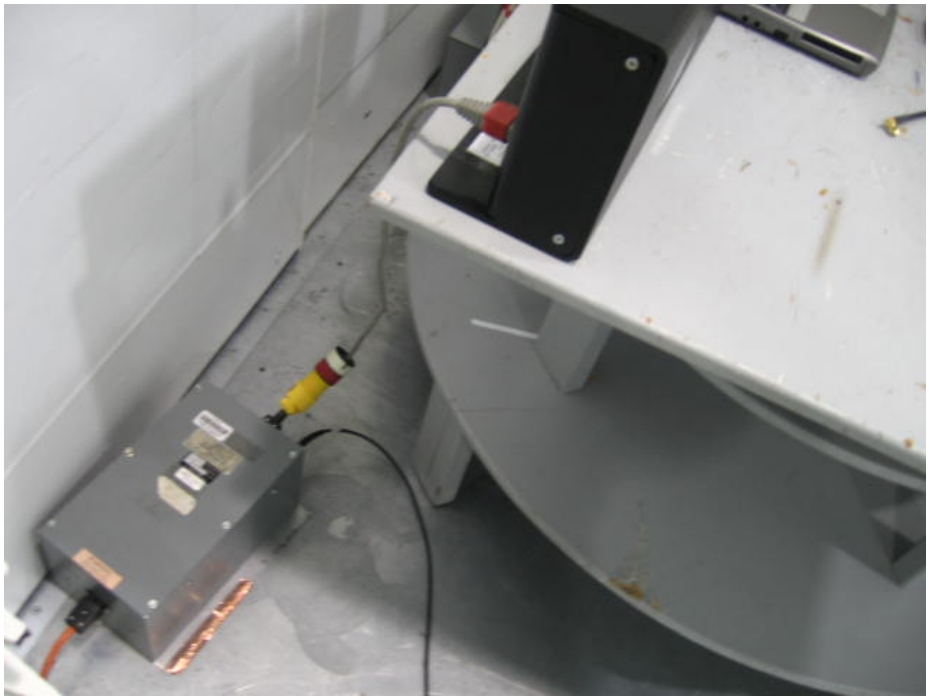
Radiated Emissions Test Configuration



Radiated Emissions Test Configuration

Radiated Emissions Test Configuration

Radiated Emissions Test Configuration



Line Conducted Emissions Test Configuration

Line Conducted Emissions Test Configuration