STC Test Report

Date : 2007-03-09
No. : HM158198

Applicant: GP Electronics (HK) Ltd.
Gold Peak Building, 6/F., 30 Kwai Wing Road,
Kwai Chung, N.T., Hong Kong.

Description of Samples:

Model name:	KEF Wireless System
Brand name:	KEF
Model no.:	KEF Wireless system
FCC ID:	UXD07003

Date Samples Received: 2006-02-07

Date Tested: 2007-02-15 to 2007-03-07

Investigation Requested: FCC Part 15 Regulations-Subpart C

Conclusions: The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

Remarks: ----

LEE Kam Chuen, EMD
For and on behalf of
The Hong Kong Standards and Testing Centre Ltd.

CONTENT:

Appendix A

Appendix B

The Hong Kong Standards and Testing Centre Ltd.
10 Dai Wang Street, Taipo Industrial Estate, N.T., Hong Kong
Tel: (852) 2666 1888 Fax: (852) 2664 4353 Homepage: www.hkstc.org E-mail: hkstc@hkstc.org

1.0 General Details

1.1 Test Laboratory

The Hong Kong Standards and Testing Centre Ltd.
EMC Laboratory
10 Dai Wang Street, Taipo Industrial Estate
New Territories, Hong Kong

1.2 Applicant Details

Applicant

GP Electronics (HK) Ltd.
Gold Peak Building, 6/F., 30 Kwai Wing Road,
Kwai Chung, N.T., Hong Kong.

Manufacturer

GP Electronics (Huizhou) Co. Ltd.
No.9, Le Jin West Road,
Zhong Kai Hi-Tech Industrial Development Zone,
Huizhou, Guangdong, PRC

1.3 Equipment Under Test [EUT]
Description of Sample

Model Name:	KEF Wireless system
Manufacturer:	GP Electronics (Huizhou) Co. Ltd.
Brand Name:	KEF
Model Number:	KEF Wireless system
Rating:	The AC/DC Adaptor used for the tests was provided by the applicant with the following details: Model Number: SA1460-220270, Input: 110-240Vd.c. 1.5A 50/60Hz, Output: 22Vd.c. 2.7A

1.3.1 Description of EUT Operation

The Equipment Under Test (EUT) is a GP Electronics (HK) Ltd., KEF Wireless system, the transmission signal is frequency hopping with channel frequency 2.403-2.479GHz.
The system is based on one-way wireless digital audio transfer from an audio source to an audio recipient. The application consists of an Atx(audio source) and an Arx(audio receiver). Atx unit connects to an audio source like e.g. a CD player or MP3 player. Arx unit is used for connection to speakers.

1.4 Date of Order

2007-02-07

1.5 Submitted Sample(s):

1 Sample

1.6 Test Duration

2007-02-15 to 2007-03-07

1.7 Country of Origin

China

2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2006 Regulations and ANSI C63.4:2003 for FCC Certification.

2.2 Test Standards and Results Summary Tables

EMISSION
Results Summary

Test Condition	Test Requirement	Test Method	Class / Severity	Test Result		
				Pass	Fail	N/A
Maximum Peak Conducted Output Power	FCC 47CFR 15.247	N/A	N/A	☒	☐	☐
Radiated Emissions	FCC 47CFR 15.209	ANSI C63.4:2003	Class B	☒	☐	☐
Frequency Range	FCC 47CFR 15.3(m)	N/A	N/A	☒	☐	☐
Hopping Channel Separation	FCC 47CFR 15.247(a)(1)	N/A	N/A	☒	☐	☐
Number of Hopping Channel	FCC 47 CFR 15.247(a)(iii)	N/A	N/A	☒	☐	☐
Pseudorandom Hopping Algorithm	FCC 47CFR 15.247(a)(1)	N/A	N/A	☒	☐	☐
Time of Occupancy	FCC 47CFR 15.247(a)(1)(iii)	N/A	N/A	☒	☐	☐
RF Exposure	FCC 47CFR 15.247 (b)(5)	N/A	N/A	☒	☐	☐
Antenna requirement	FCC 47 CFR 15.203	N/A	N/A	☒	☐	☐
Conducted Emissions on AC, 0.15MHz to 30MHz	FCC 47CFR 15.207	ANSI C63.4:2003	Class B	☒	☐	☐

Note: N/A - Not Applicable

3.0 Test Results

3.1 Emission

3.1.1 Maximum Peak Conducted Output Power

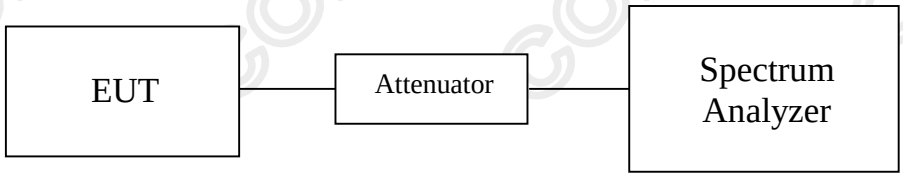
Test Requirement: FCC 47CFR 15.247(b)(1)
Test Date: 2007-03-07
Mode of Operation: Tx mode

Test Method:

The transmitter output was connected to the spectrum / receiver through an attenuator. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 1MHz RBW and 1MHz VBW. Use Peak Search to read the peak power after Maximum Hold function is activated.

*:

Test Setup:



Limits for Peak Output Power of Fundamental Emissions [FCC 47CFR 15.247]:

The maximum peak output power shall not exceeded the following limits: For frequency hopping systems operating in the 2400-2483.5 MHz Band: 1 Watt (30dBm)

Results of transmission Mode (2.4033GHz to 2.4791GHz) : Pass (TX Unit)
Maximum Peak Conducted Output Power

Channel	Frequency (MHz)	Conducted Power (dBm)
0	2403.1	19.54
19	2442.2	13.01
37	2479.4	19.03

Results of transmission Mode (2.4033GHz to 2.4791GHz) : Pass (TX Unit)
Maximum EIRP

Channel	Frequency (MHz)	Transmitter Power (dBm)
0	2403.1	9.54
19	2442.2	12.79
37	2479.4	8.45

Calculated measurement uncertainty : 30MHz to 1GHz ±5.2dB
1GHz to 18GHz ±4.4dB

Antenna Gain dBi = Maximum EIRP (dBm) – Maximum Peak Conducted Output Power (dBm)

Transmission Frequency (MHz)	2403.1	2442.2	2479.4
Antenna Gain (dBi)	-10	-0.2	-10.6

3.1.2 Radiated Emissions

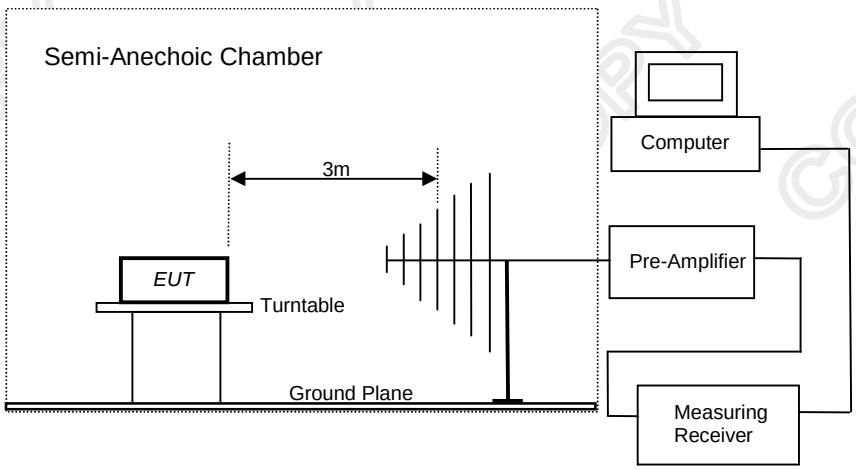
Test Requirement:	FCC 47CFR 15.247
Test Method:	ANSI C63.4:2003
Test Date:	2007-03-07
Mode of Operation:	Tx mode

Test Method:

The sample was placed 0.8m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

*: Semi-anechoic chamber located on the G/F of HKSTC with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 607756.

Test Setup:



Limits for Field Strength of Harmonics Emissions [FCC 47CFR 15.209]:

Frequency Range [MHz]	Quasi-Peak Limits [V/m]
30-88	100
88-216	150
216-960	200
Above960	500

Results of Transmit Mode (Channel 0, 2403.1MHz) : Pass

Field Strength of Harmonics Emissions Average Value						
Frequency MHz	Measured Level @3m dBµV/m	Correction Factor dBµV/m	Field Strength dBµV/m	Field Strength µV/m	Limit @3m µV/m	E-Field Polarity
* 4806.8	**No Emission Detected**				500	Vertical
* 7210.2					500	Vertical
9613.6					500	Vertical
* 12017.0					500	Vertical
14420.4					500	Vertical
16823.8					500	Vertical
* 19227.2					500	Vertical
* 21630.6					500	Vertical
24034.0					500	Vertical

Remarks:

*: Denotes restricted band of operation.
Measurements were made using a peak detector. Any emission less than 1000 MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Calculated measurement uncertainty : 30MHz to 1GHz ±5.2dB
1GHz to 18GHz ±4.4dB

Limits for Field Strength of Harmonics Emissions [FCC 47CFR 15.209]:

Frequency Range [MHz]	Quasi-Peak Limits [V/m]
30-88	100
88-216	150
216-960	200
Above960	500

Results of Transmit Mode (Channel 19, 2442.2MHz) : Pass

Field Strength of Harmonics Emissions Average Value						
Frequency MHz	Measured Level @3m dBµV/m	Correction Factor dBµV/m	Field Strength dBµV/m	Field Strength µV/m	Limit @3m µV/m	E-Field Polarity
* 4884.4	**No Emission Detected**				500	Vertical
* 7326.6					500	Vertical
9768.8					500	Vertical
* 12211.0					500	Vertical
14653.2					500	Vertical
17095.4					500	Vertical
* 19537.6					500	Vertical
* 21979.8					500	Vertical
24422.0					500	Vertical

Remarks:

*: Denotes restricted band of operation.
Measurements were made using a peak detector. Any emission less than 1000 MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Calculated measurement uncertainty : 30MHz to 1GHz ±5.2dB
1GHz to 18GHz ±4.4dB

Limits for Field Strength of Harmonics Emissions [FCC 47CFR 15.209]:

Frequency Range [MHz]	Quasi-Peak Limits [V/m]
30-88	100
88-216	150
216-960	200
Above960	500

Results of Transmit Mode (Channel 37, 2479.4MHz) : Pass

Field Strength of Harmonics Emissions Average Value						
Frequency MHz	Measured Level @3m dBµV/m	Correction Factor dBµV/m	Field Strength dBµV/m	Field Strength µV/m	Limit @3m µV/m	E-Field Polarity
* 4958.4	**No Emission Detected**				500	Vertical
* 7437.6					500	Vertical
9916.8					500	Vertical
* 12396.0					500	Vertical
14875.2					500	Vertical
17354.4					500	Vertical
* 19833.6					500	Vertical
* 22312.8					500	Vertical
24792.0					500	Vertical

Remarks:

*: Denotes restricted band of operation.
Measurements were made using a peak detector. Any emission less than 1000 MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Calculated measurement uncertainty : 30MHz to 1GHz ±5.2dB
1GHz to 18GHz ±4.4dB

Limits for Radiated Emissions other than Fundamental and Harmonics emissions [FCC 47 CFR 15.209 Class B]:

Frequency Range [MHz]	Quasi-Peak Limits [V/m]
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Results of Transmit Mode: Pass

Emission Frequency MHz	E-Field Polarity	Level @3m dBµV/m	Limit @3m dBµV/m	Level @3m µV/m	Limit @3m µV/m
203.5	Horizontal	35.6	43.5	60.3	150.0
231.4	Horizontal	44.9	43.5	175.8	150.0

Remarks:

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty : 30MHz to 1GHz ±5.2dB
1GHz to 18GHz ±4.4dB

3.2 Frequency Range Measurement

Test Requirement:	FCC 47 CFR 15.247
Test Date:	2007-02-15
Mode of Operation:	On mode

Test Method:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

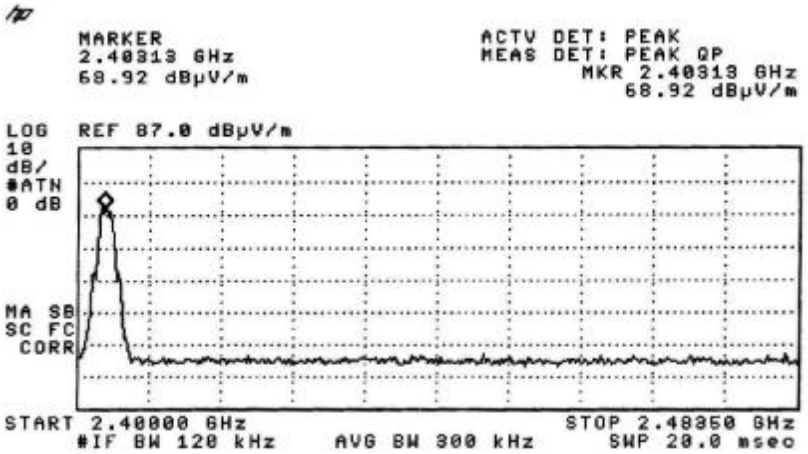
Test Setup:

As Test Setup of clause 3.1.1 in this test report.

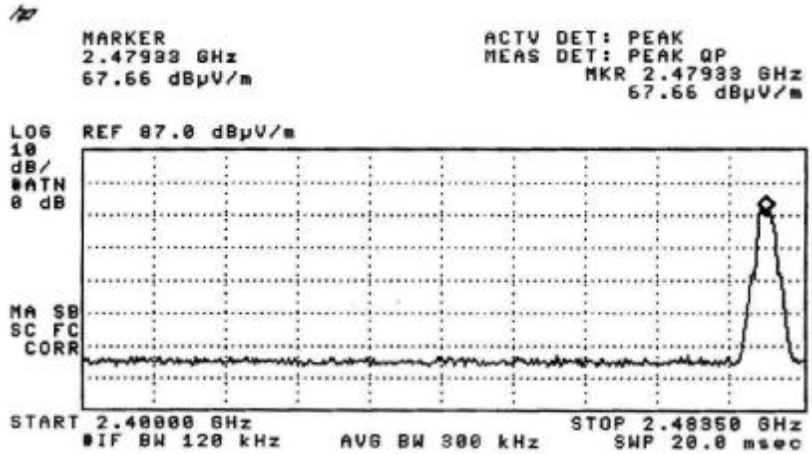
Limits for Frequency Range Measurement:

Frequency Range [MHz]	FCC Limits [MHz]
2403-2478	within 2400-2483.5

Lowest Operating Frequency



Highest Operating Frequency



3.3 Hopping Channel Separation Measurement

Test Requirement: FCC 47 CFR 15.247(a)(1)
Test Date: 2007-03-07
Mode of Operation: Tx mode

Test Method:

The transmitter output was connected to the spectrum / receiver through an attenuator. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 30kHz RBW and 100kHz VBW. Use Peak Search to read the peak power after Maximum Hold function is activated.

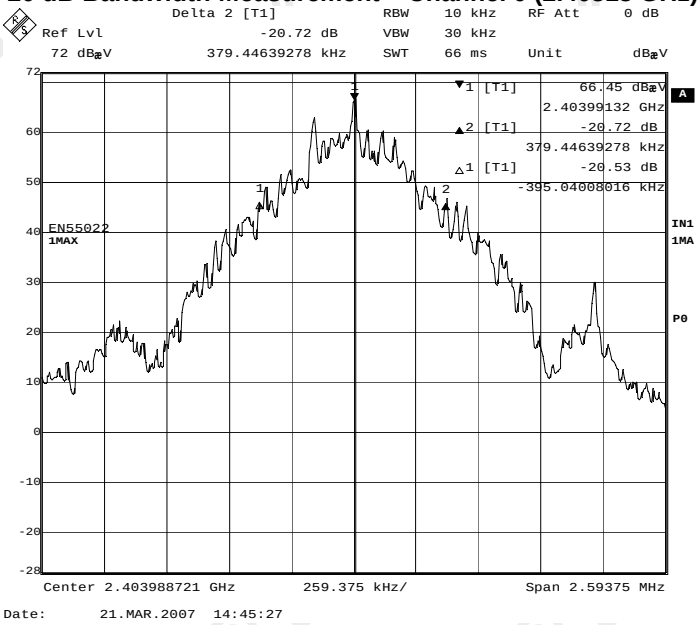
Test Setup:

As Test Setup of clause 3.1.1 in this test report.

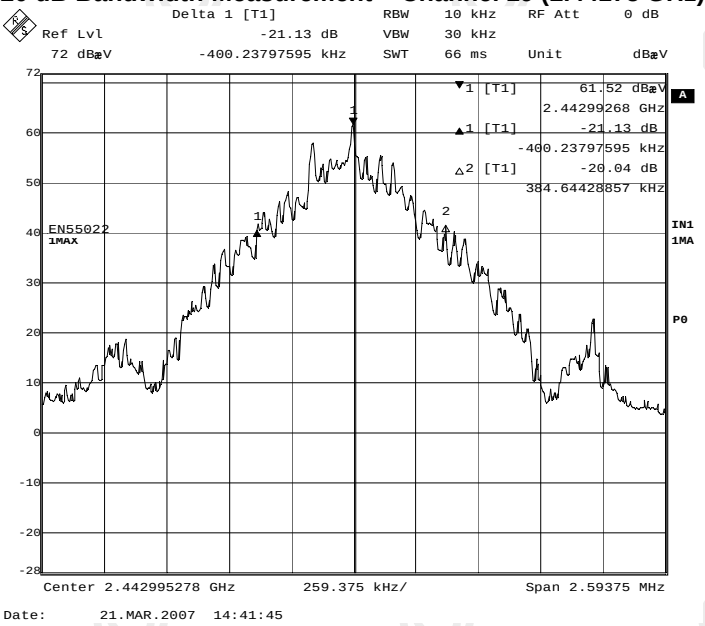
Limits:
Channel Separation Limits: >20dB bandwidth or 2/3 of 20dB bandwidth

Channel	Frequency (GHz)	Channel Separation (MHz)	20dB Bandwidth (kHz)
0	2.403328	2.048	774.48
19	2.442240	2.048	784.88
37	2.479104	2.048	784.88

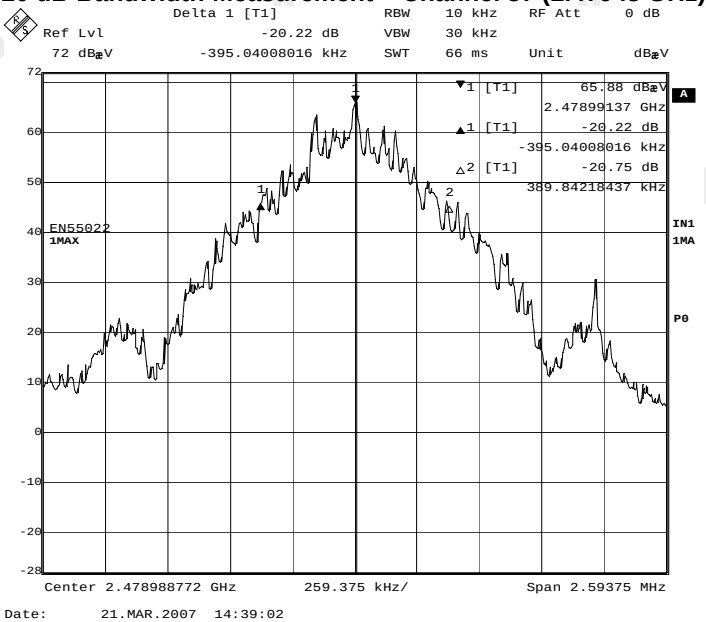
20 dB Bandwidth Measurement – Channel 0 (2.40313 GHz)



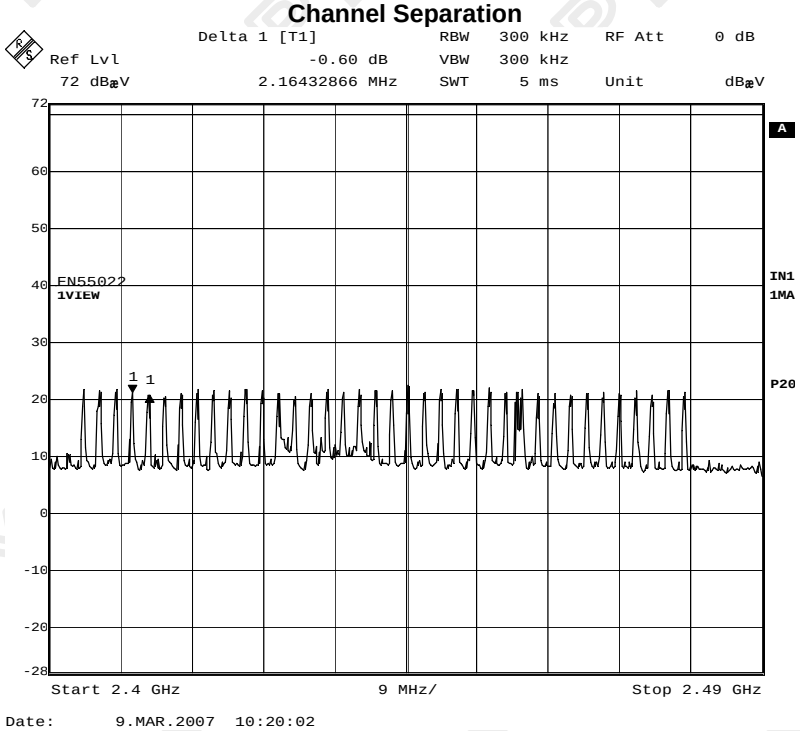
20 dB Bandwidth Measurement – Channel 19 (2.44175 GHz)



20 dB Bandwidth Measurement – Channel 37 (2.47943 GHz)



Channel Separation



3.4 Number of Hopping Channel Measurement

Test Requirement: FCC 47 CFR 15.247(a)(iii)
Test Date: 2007-03-07
Mode of Operation: Tx mode

Test Method:

The transmitter output was connected to the spectrum / receiver through an attenuator. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 500kHz RBW and 500kHz VBW. Use Peak Search to read the peak power after Maximum Hold function is activated.

Test Setup:

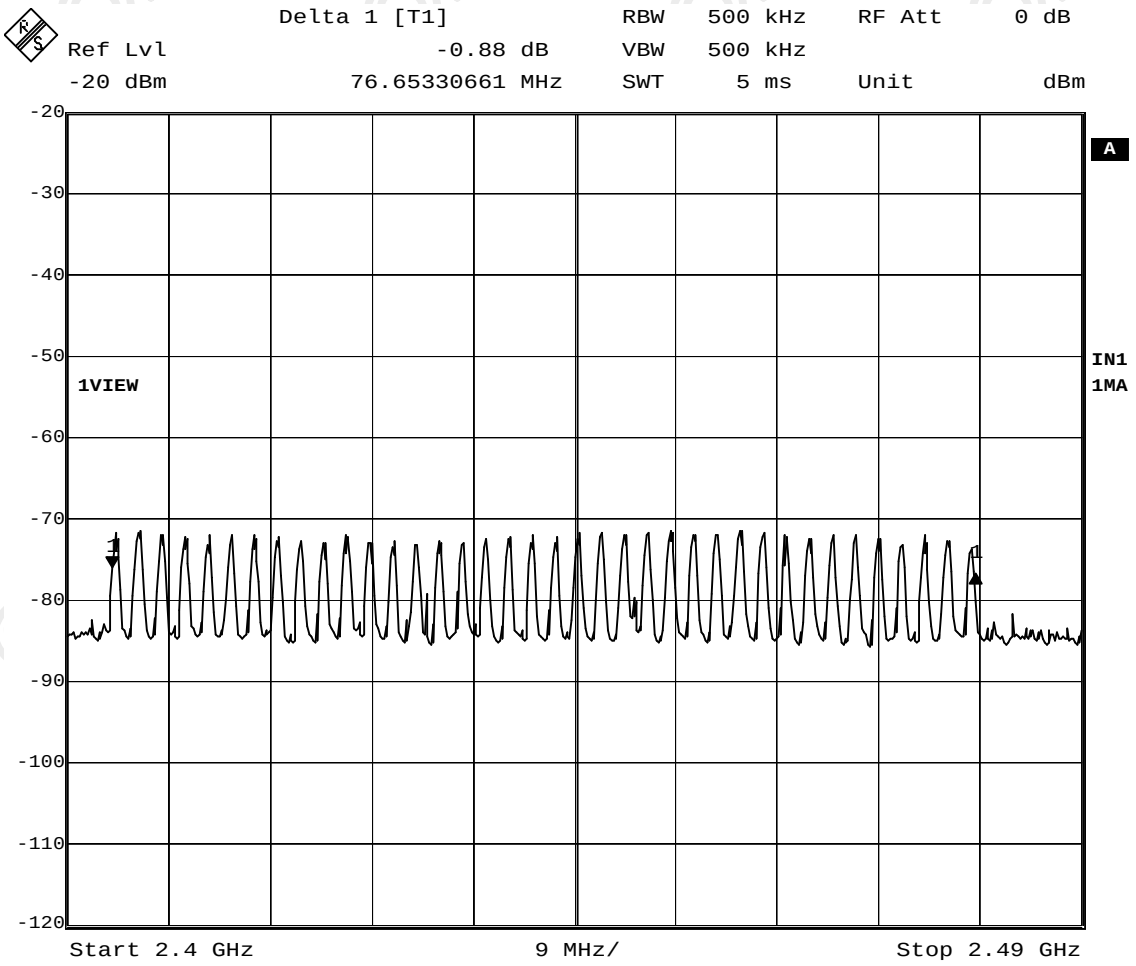
As Test Setup of clause 3.1.1 in this test report.

Channel Frequency Table

Channel	Centre Frequency (GHz)	Channel	Centre Frequency (GHz)
0	2.403328	19	2.442240
1	2.405376	20	2.444288
2	2.407424	21	2.446336
3	2.409472	22	2.448384
4	2.411520	23	2.450432
5	2.413568	24	2.452480
6	2.415616	25	2.454528
7	2.417664	26	2.456576
8	2.419712	27	2.458624
9	2.421760	28	2.460672
10	2.423808	29	2.462720
11	2.425856	30	2.464768
12	2.427904	31	2.466816
13	2.429952	32	2.468864
14	2.432000	33	2.470912
15	2.434048	34	2.472960
16	2.436096	35	2.475008
17	2.438144	36	2.477056
18	2.440192	37	2.479104

Limits:
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels.

Number of Hopping Channel



Date: 1.MAR.2007 08:56:04

3.5 Pseudorandom Hopping Algorithm

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

Pseudo random properties of the embedded FHSS engine

The embedded FHSS engine uses 38 hopping locations, out of which 18 are non-overlapping channels. The hopping sequence is contained in a table with the 38 frequency location entries staggered in a pseudorandom order. A single data frame is transmitted on each frequency location before skipping to the next hopping frequency in the list. Upon completion of the list, the hopping sequence is repeated on a cyclic basis.

Upon reception of faulty/no data, the frequency(ies) resulting in loss of data is temporarily removed from the hopping list. The hopping sequence cycle is thus correspondingly shortened. The frequency locations resulting in loss of data are added to a list of banned frequencies containing the frequency locations unsuitable for use. The list is limited to a maximum number.

In normal operation, the initial pseudorandom list of frequency hopping locations is volatile in terms of the number of hopping frequencies in use and the sequence of which they occur. These elements combined result in an unpredictable hopping sequence with pseudorandom properties.

3.6 Time of Occupancy

Requirements:

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channel employed.
No requirements for Digital Transmission System.

Measurement Data: Number of RF channel: 38
RF burst pr channel: 1.76 ms
Time between each RF burst on same RF channel: 80.16 ms

Time of occupancy: ((1.76ms / 80.16ms)) * 0.4s * 38)s = 0.33 sec

See fig. A and B.

Fig. A Time between RF Burst

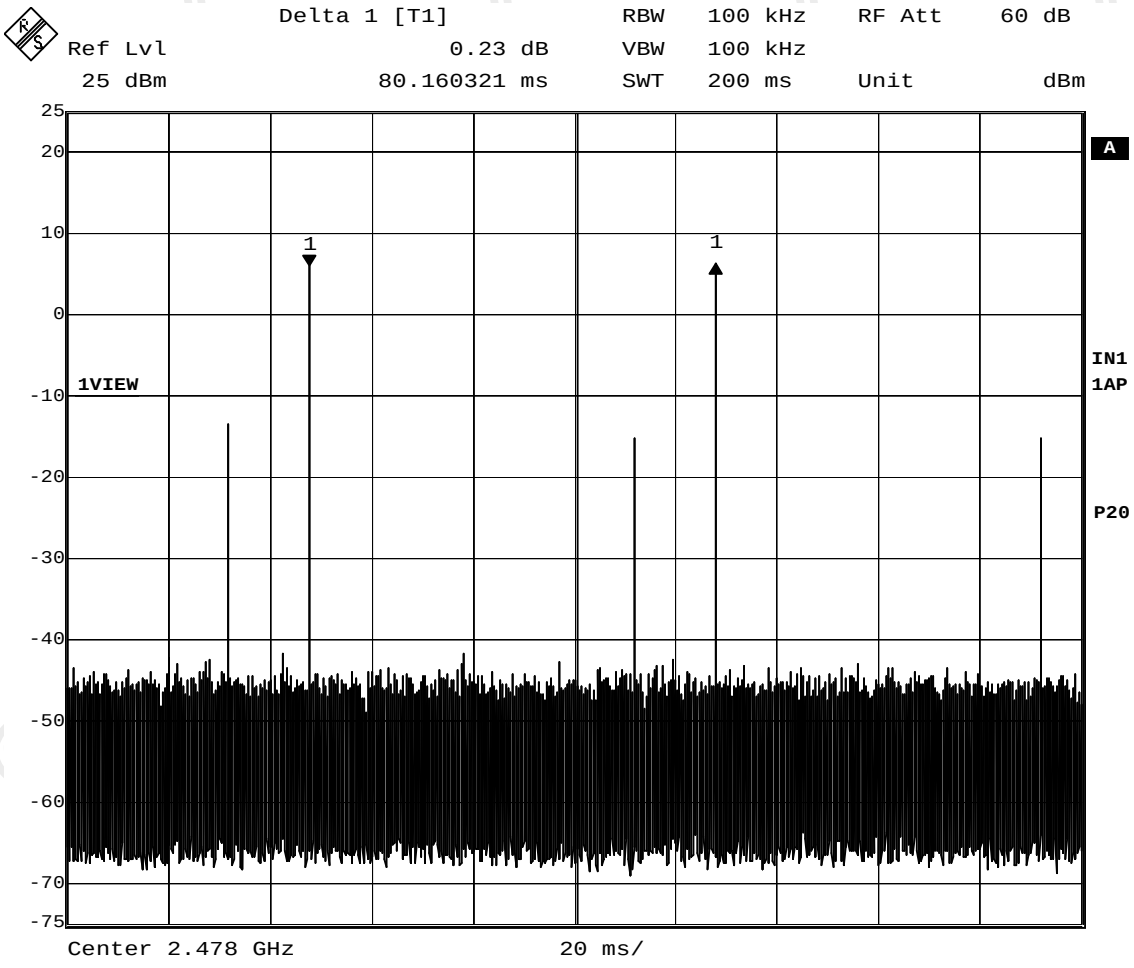
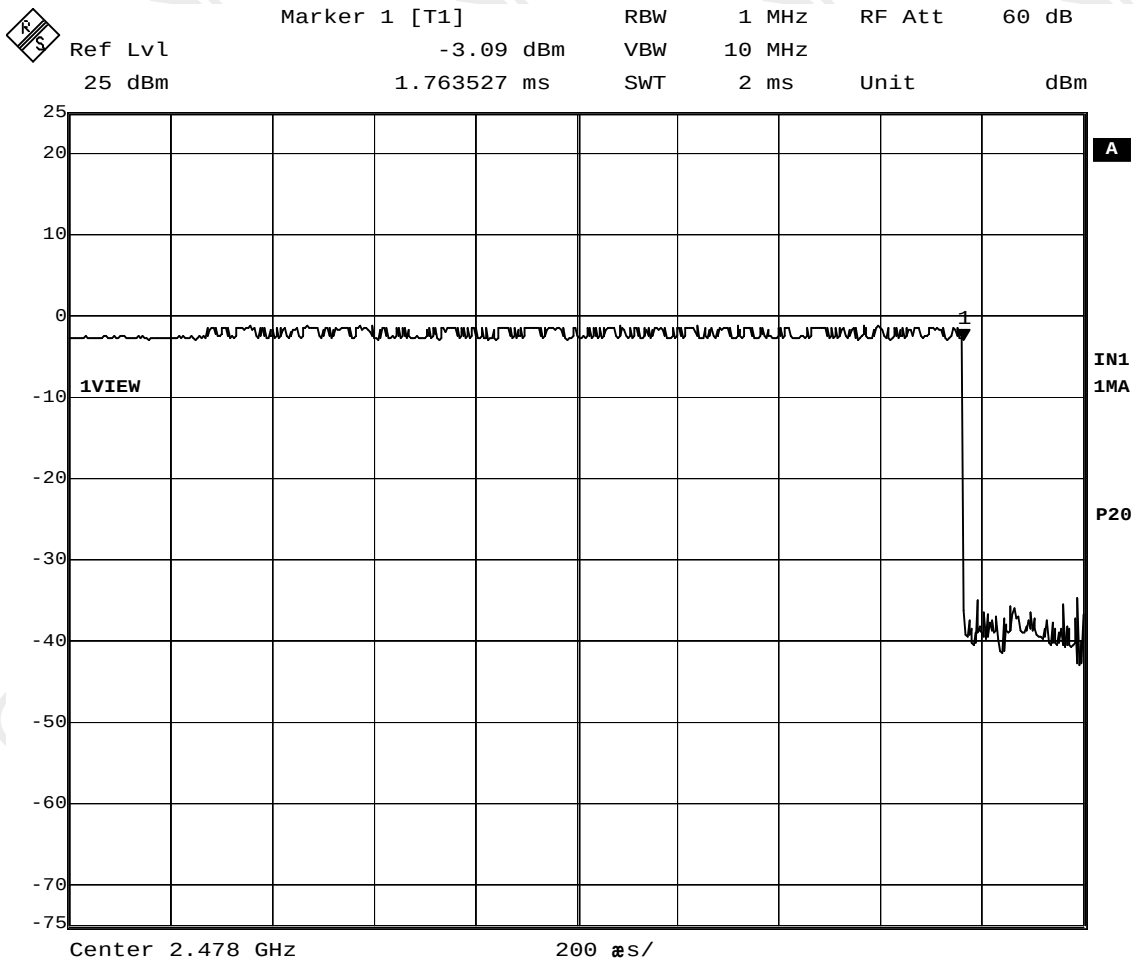


Fig B . RF Burst



3.7 RF Exposure

Test Requirements: **§15.247(b)(5); §1.1307(b)(1)**

Test Specification: Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

Test Results: The EUT complied with the requirement(s) of this section.
EUT meets the requirements of these sections as proven through MPE calculation

The MPE calculation for EUT @ 20cm
Based on the highest P = 20 mW

$Pd = PG/ 4pi*R^2 = (20x 0.95)/12.566* (20)^2$
$= (19)/12.56637x 400= 99.84 / 5026.55$
$= 0.037 \ mW/cm^2$

where:

*Pd = power density in mW/cm^2
* G = Antenna numeric gain (0.95); Log G = g/10 (g = -0.2).
* P = Conducted RF power to antenna (20 mW).
* R = Minimum allowable distance.(20 cm)

*The power density Pd = 0.02 mW/cm^2 is less than 1 mW/cm^2 (listed MPE limit)
*The SAR evaluation is not needed (this is a desk top device, R> 20 cm)
* The EUT(antenna) must be 0.2 meters away from the General Population.

3.8 Antenna Requirement

Test Requirements: S15.203

Test Specification:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Test Results:

The EUT antenna is permanently attached to the main unit and attached on PCB board. User unable to remove or change the antenna.

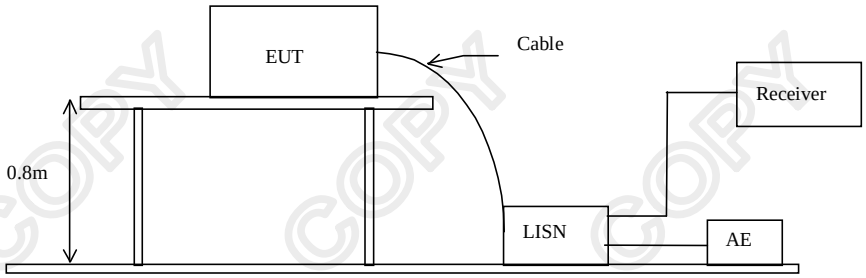
3.9 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC 47CFR 15.207
Test Method:	ANSI C63.4:2003
Test Date:	2007-02-15
Mode of Operation:	Tx Mode

Test Method:

The test was performed in accordance with ANSI C63.4: 2003, with the following: an initial measurement was performed in peak and average detection mode on the live line, any emissions recorded within 30dB of the relevant limit line were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

Test Setup:



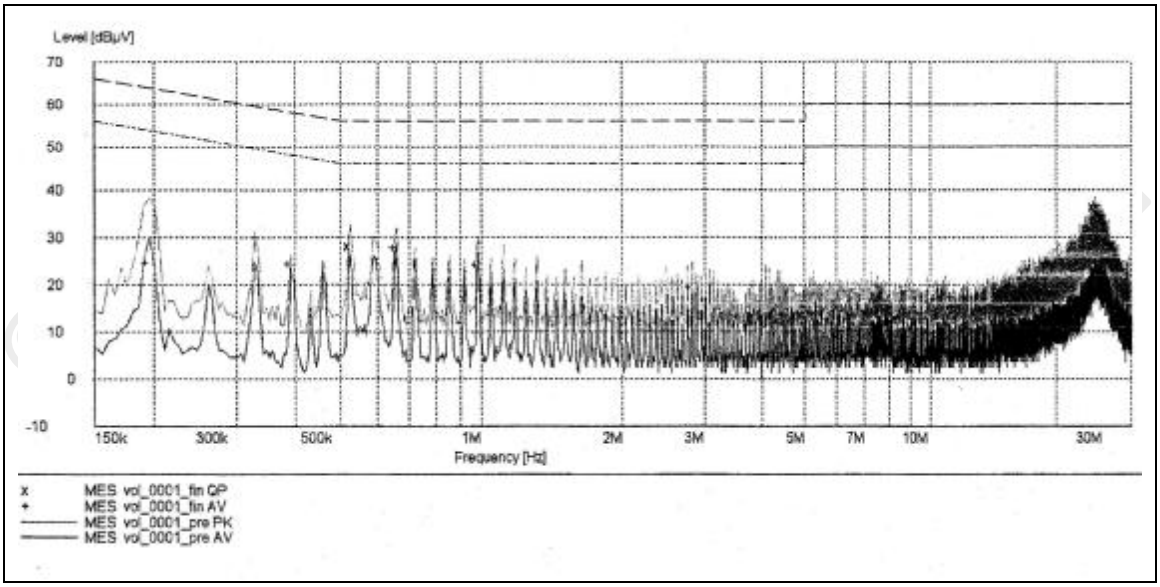
Limit for Conducted Emissions (FCC 47 CFR 15.207):

Frequency Range [MHz]	Quasi-Peak Limits [dBµV]	Average [dBµV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

Results of Tx Mode: PASS



Results of Tx Mode: PASS

Conductor Live or Neutral	Frequency MHz	Quasi-peak		Average	
		Level dBµV	Limit dBµV	Level dBµV	Limit dBµV
Live	0.195	-*-	-*-	24.5	54
Live	0.390	-*-	-*-	24.3	48
Live	0.655	-*-	-*-	27.7	46
Live	0.980	-*-	-*-	24.1	46
Live	2.810	-*-	-*-	19.2	46
Neutral	0.525	28.1	56	-*-	-*-
Neutral	24.555	36.5	60	-*-	-*-
Neutral	24.750	-*-	-*-	32.8	50

Remarks:

Calculated measurement uncertainty : ±3.97dB
-*- Emission(s) that is far below the corresponding limit line.

Appendix A

List of Measurement Equipment

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.
EM007	SPECTRUM ANALYZER	HEWLETT PACKARD	HP85660B	3144A21192
EM008	SPECTRUM ANALYZER DISPLAY	HEWLETT PACKARD	HP85662A	3144A20514
EM009	QUASI PEAK ADAPTOR	HEWLETT PACKARD	HP85650A	3303A01702
EM010	RF PRESELECTOR	HEWLETT PACKARD	HP85685A	3221A01410
EM011	ATTENUATOR/SWITCH	HEWLETT PACKARD	HP11713A	2508A10595
EM012	PRE-AMPLIFIER	HEWLETT PACKARD	HP8449B	3008A00262
EM020	HORN ANTENNA	ETS-Linggren	3115	4032
EM022	LOOP ANTENNA	ETS-Linggren	6502	1189-2424
EM072	SIGNAL GENERATOR	HEWLETT PACKARD	8640B	1948A11892
EM083	OPEN AREA TEST SITE	HKSTC	N/A	N/A
EM131	EMC ANALYZER	HEWLETT PACKARD	8595EM	3710A00155
EM145	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESCS 30	830245/021
EM195	ANTENNA POSITIONING MAST	ETS-Linggren	2075	2368
EM196	MULTI-DEVICE CONTROLLER	ETS-Linggren	2090	1662
EM215	MULTIDEVICE CONTROLER	ETS-Linggren	2090	00024676
EM216	MINI MAST SYSTEM	ETS-Linggren	2075	00026842
EM217	ELECTRIC POWERED TURNTABLE	ETS-Linggren	2088	00029144
EM218	ANECHOIC CHAMBER	ETS-Linggren	FACT-3	--
EM219	BICONILOG ANTENNA	ETS-Linggren	3142C	00029071
EM229	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB40	100248

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.
EM078	VARIAC	SHANGHAI VOLTAGE	TDGC-3/0.5	N/A
EM081	SMALL SCREENED ROOM	MIKO INST HK	N/A	N/A
EM119	LISN	ROHDE & SCHWARZ	ESH3-Z5	0831.5518.52
EM127	ISOLATION TRANSFORMER 220 TO 300V	WING SUN	N/A	N/A
EM233	PULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	100314
EM181	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	100072
EM154	SHIELDING ROOM	SIEMENA MATSUSHITA COMPONENTS	N/A	803-740-057-99A
M197	LISN	ETS-Linggren	4825/2	1193

Remarks:-

CM Corrective Maintenance
N/A Not Applicable or Not Available
TBD To Be Determined

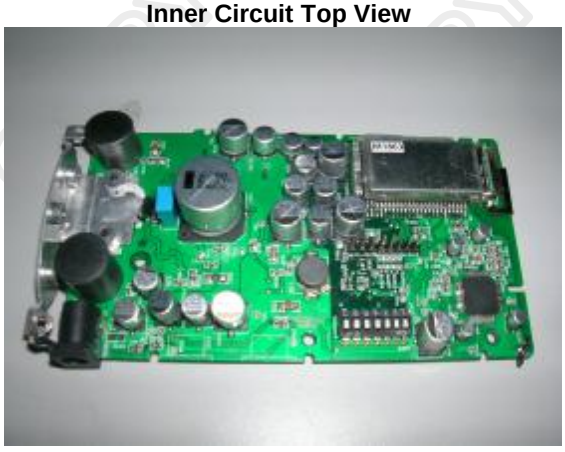
Appendix B

Photographs of EUT

Front View of the product

Rear View of the product

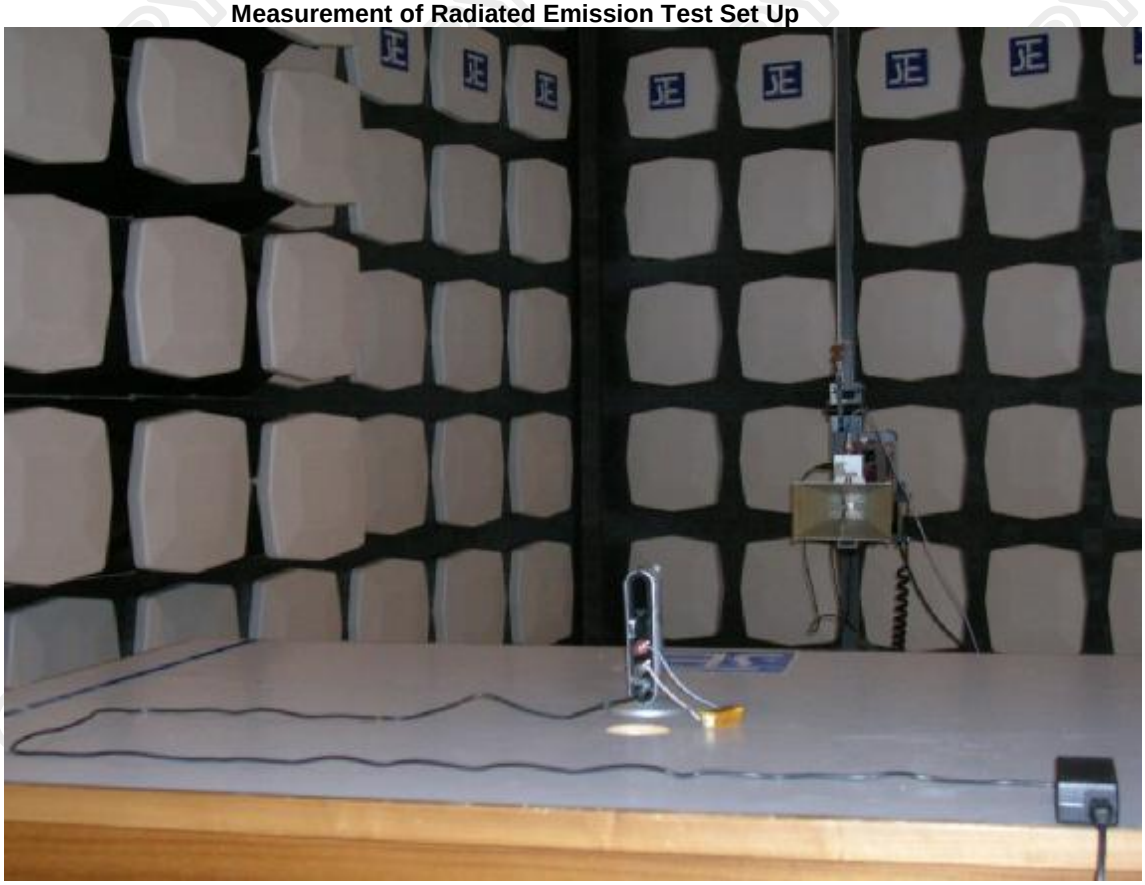
Inner Circuit Top View



Inner Circuit Bottom View

Photographs of EUT

Measurement of Radiated Emission Test Set Up



Photographs of EUT

Measurement of Conducted Emission Test Set Up

******* End of Test Report *******