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Auftraggeber: <i>Client:</i>		ION Audio LLC 200 Scenic View Drive Suite 201, Cumberland RI 02864 USA			
Gegenstand der Prüfung: Wireless Speaker for iPod/iPhone <i>Test item:</i>					
Bezeichnung: <i>Identification:</i>	iSPOF	FCC ID: <i>FCC ID</i>	Y40FREESOUND		
Wareneingangs-Nr.: <i>Receipt No.:</i>	173061380	Eingangsdatum: <i>Date of receipt:</i>	01.Aug.2011		
Prüfart: <i>Testing location:</i>	TÜV Rheinland (Guangdong) Ltd. EMC Laboratory Guangzhou Auto Market, Yuan Gang Section of Guangshan Road, Guangzhou 510650, P. R. China		Listed test laboratory according to FCC rules section 2.948 for measuring devices under Parts 15		
Prüfgrundlage: <i>Test specification:</i>	ANSI C63.4: 2009 FCC Part 15: October 01, 2010 Subpart C section 15.207, 15.209 and 15.247				
Prüfresultat: <i>Test Result:</i>	Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n). <i>The test item passed the test specification(s).</i>				
Prüflaboratorium: <i>Testing Laboratory:</i>	TÜV Rheinland (Guangdong) Ltd.				
geprüft/ tested by:		kontrolliert/ reviewed by:			
18.Aug.2011	Frank Du Project Engineer	23. Aug. 2011	Liangdong Xie Project Manager		
<i>Datum</i> <i>Date</i>	<i>Name/Stellung</i> <i>Name/Position</i>	<i>Unterschrift</i> <i>Signature</i>	<i>Unterschrift</i> <i>Signature</i>		
Sonstiges/ Other Aspects:					
<table border="0" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> Abkürzungen: P(ass) = entspricht Prüfgrundlage F(ail) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet </td> <td style="width: 50%; vertical-align: top;"> Abbreviations: P(ass) = passed F(ail) = failed N/A = not applicable N/T = not tested </td> </tr> </table>				Abkürzungen: P(ass) = entspricht Prüfgrundlage F(ail) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet	Abbreviations: P(ass) = passed F(ail) = failed N/A = not applicable N/T = not tested
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Test Summary

FCC Rules		Test items	Result
Paragraph	Released Date		
Part 15 Per Section 15.207(a)	October 01, 2010	Conducted Emission	Pass
Part 15 Per Section 15.209(a)	October 01, 2010	Radiated Spurious Emission	Pass
Part 15 Per Section 15.203	October 01, 2010	Antenna requirement	Pass
Part 15 Per Section 15.247(b)(1)	October 01, 2010	Maximum Peak Output power	Pass
Part 15 Per Section 15.247(a)(1)	October 01, 2010	20dB Bandwidth	Pass
Part 15 Per Section 15.247(a)(1)	October 01, 2010	Hopping Channel Carrier Frequency Separation	Pass
Part 15 Per Section 15.247(a)(1)(iii)	October 01, 2010	Number of Hopping Frequency Used	Pass
Part 15 Per Section 15.247(a)(1)(iii)	October 01, 2010	Time of Occupancy (Dwell Time)	Pass
Part 15 Per Section 15.247(d)	October 01, 2010	Out-Of-Band Emission measurement	Pass

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1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix 1: Test result

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Guangdong) Ltd. EMC Laboratory

Guangzhou Auto Market, Yuan Gang Section of Guangshan Road
Guangzhou 510650

P. R. China

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2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Equipment	Manufacturer	Type	Serial No.	Calibrated until
TÜV Rheinland (Guangdong) Ltd.				
EMI Test Receiver	Rohde & Schwarz	ESCI-3	100216	16.Mar.2012
Spectrum Analyzer	Rohde & Schwarz	FSP30	100286	16.Mar.2012
Trilog-Broadband Antenna	SCHWARZBECK MESS- ELEKTRONIK	VULB9168	209	07.Nov.2012
Trilog-Broadband Antenna	SCHWARZBECK MESS- ELEKTRONIK	VULB9168	210	26.Jun.2012
Double-Ridged Waveguide Horn Antenna	Rohde & Schwarz	HF906	100385	18.Jul.2012
Double-Ridged Waveguide Horn Antenna	Rohde & Schwarz	HF906	100407	26.Jun.2012
Pre-amplifier	MITEQ	AFS42-00101800-25-S-42	1101599	31.Jul.2012
Band Reject Filter	Micro-Tronics	BRM50702	023	14.Mar.2012
Precision Dipole	Schwarzbeck	VHAP	1180+1109	22.Dec.2012
Precision Dipole	Schwarzbeck	UHAP	1091+1092	26.Jun.2012
Standard Gain Horn Antenna	EMCO	3160-09	21642	26.Jun.2012
Standard Gain Horn Antenna	EMCO	3160-09	21645	N/A
Pre-amplifier	MITEQ	AFS33-18002650-30-8P-44	1108282	16.Mar.2012
3m Anechoic Chamber	Albatross Project GmbH	N/A	N/A	16.Apr.2012
Climatic Chamber	ESPEC	EL-04 KA	6107116	16.Mar.2012
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100111	16.Mar.2012
Spectrum analyzer	Agilent	E4404B	MY41440753	16.Mar.2012
Communication Analyser	Hewlett-Packard	8920A	3906A10633	03.Nov.2011

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2.3 Traceability

All measurement equipment calibrations are traceable to NIST or where calibration is performed outside the United States, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications.

2.5 Measurement Uncertainty

Uncertainty for conducted emissions measurements is $\pm 2.68\text{dB}$.

Uncertainty for radiated emissions measurements is $\pm 4.94\text{dB}$ (30M-1GHz) and $\pm 4.88\text{dB}$ ($> 1\text{GHz}$)

The reported expanded uncertainty is based on a standard uncertainty multiply by a coverage factor $k=2$, providing a level of confidence of approximately 95%.

2.6 Location of original data

The original copies of test data taken during actual testing were attached at Appendix 1 of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Guangdong) file for certification follow-up purposes.

2.7 Status of facility used for testing

TÜV Rheinland (Guangdong) Ltd. EMC Laboratory; Guangzhou Auto Market, Yuan Gang Section of Guangshan Road, Guangzhou 510650, P. R. China is listed on the US Federal Communications Commission list of facilities approved to perform measurements, the register no. 833845.

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3 General Product Information

The submitted sample is wireless speaker transmitter operating within the frequency range of 2409.0 MHz to 2475.0MHz.

For details, refer to technical document and the user manual.

3.1 Product Function and Intended Use

Refer to the Technical Documentation and user manual.

3.2 Ratings and System Details

Type Designation	:	iSPOF
Frequency range	:	CH1:2409.0MHz CH8:2423.0MHz CH15:2441.0MHz CH22:2459.0MHz CH2:2411.0MHz CH9:2425.0MHz CH16:2443.0MHz CH23:2461.0MHz CH3:2413.0MHz CH10:2427.0MHz CH17:2449.0MHz CH24:2465.0MHz CH4:2415.0MHz CH11:2429.0MHz CH18:2451.0MHz CH25:2467.0MHz CH5:2417.0MHz CH12:2431.0MHz CH19:2453.0MHz CH26:2469.0MHz CH6:2419.0MHz CH13:2435.0MHz CH20:2455.0MHz CH27:2473.0MHz CH7:2421.0MHz CH14:2437.0MHz CH21:2457.0MHz CH28:2475.0MHz
RF output power	:	10mW (e.r.p)
Channel bandwidth	:	2.0 MHz
Type Of Modulation	:	GFSK
Hopping mode	:	FHSS
Type of antenna	:	Integrated antenna
FCC ID	:	Y40FFREESOUND
Power Supply	:	AC 100-240V
Frequency	:	50/60Hz
Protection Class	:	II

Refer to the Technical Documentation for further information.

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3.3 Independent Operation Modes

Transmitting without modulation

Transmitting with modulation

For further information refer to User Manual

3.4 Submitted Documents

Block Diagram

Schematics

Operation Description

Components List

Label and location

User Manual

4 Test Set-up and Operation Mode

4.1 Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Refer to test set-up in chapter 5.

4.3 Special Accessories and Auxiliary Equipment

None.

4.4 Countermeasures to achieve EMC Compliance

The test sample, which has been tested, contained the noise suppression parts as described in the technical document. No additional measures were employed to achieve compliance.

4.5 Test set-up

Diagram 1 of Configuration for Testing Radiated Emission 30MHz -1 GHz

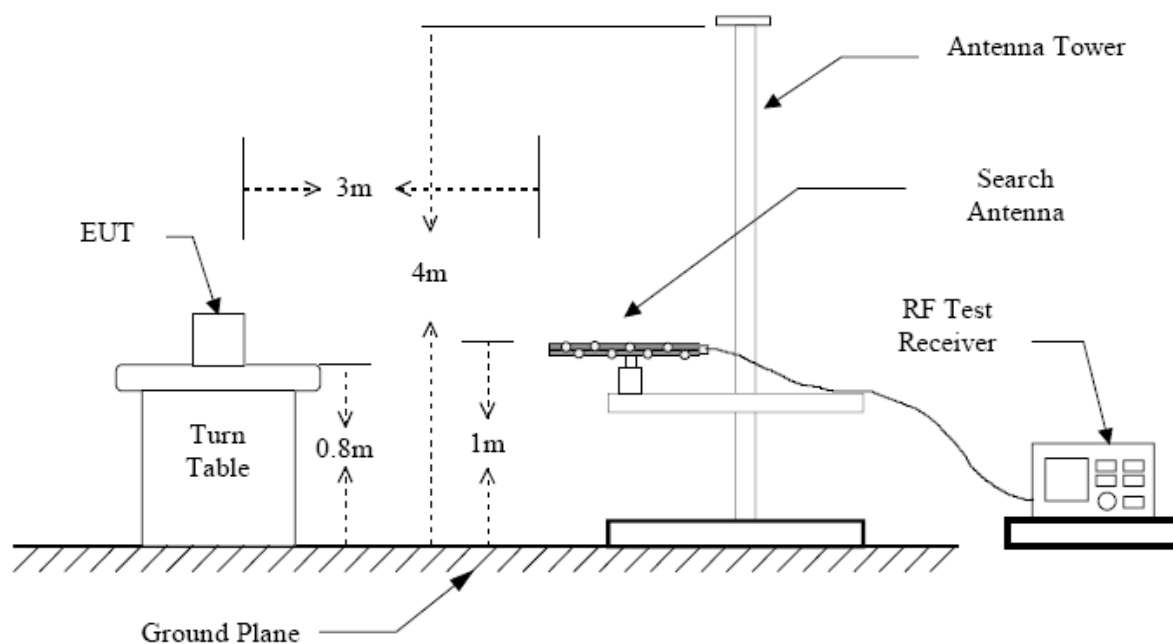


Diagram 2 of Configuration for Testing Radiated Emission above 1 GHz

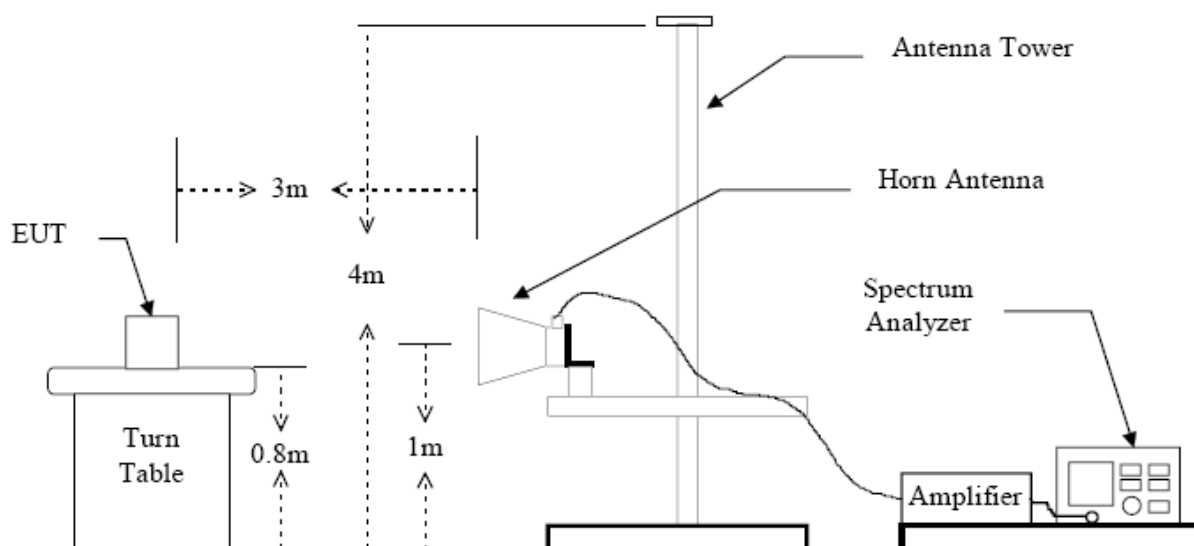


Diagram 3 of Configuration for Testing Conducted Emission

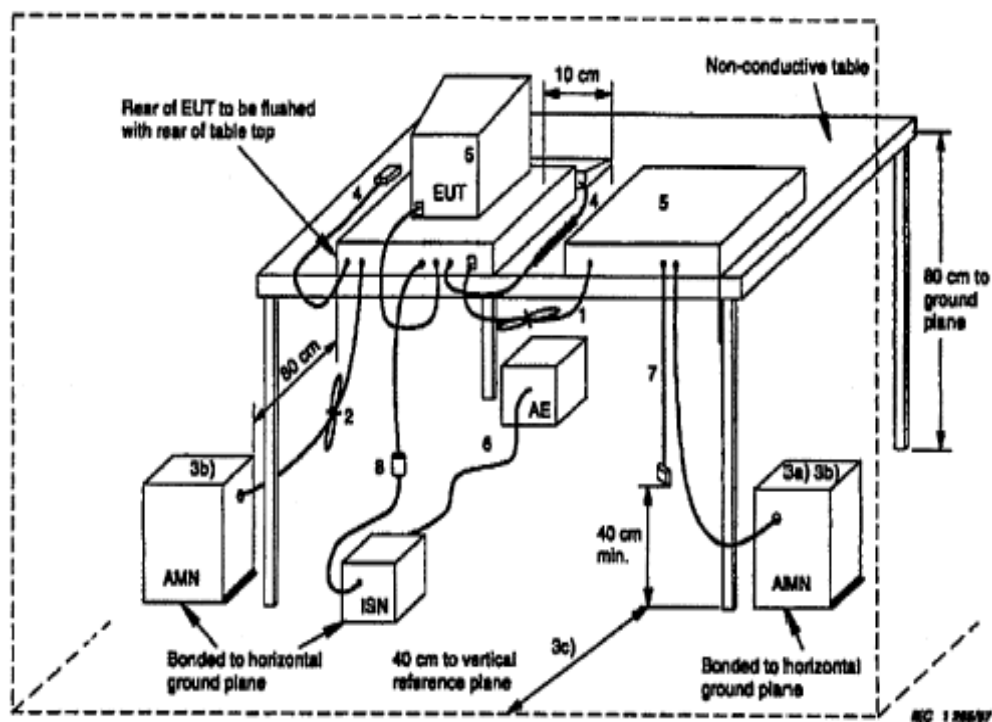
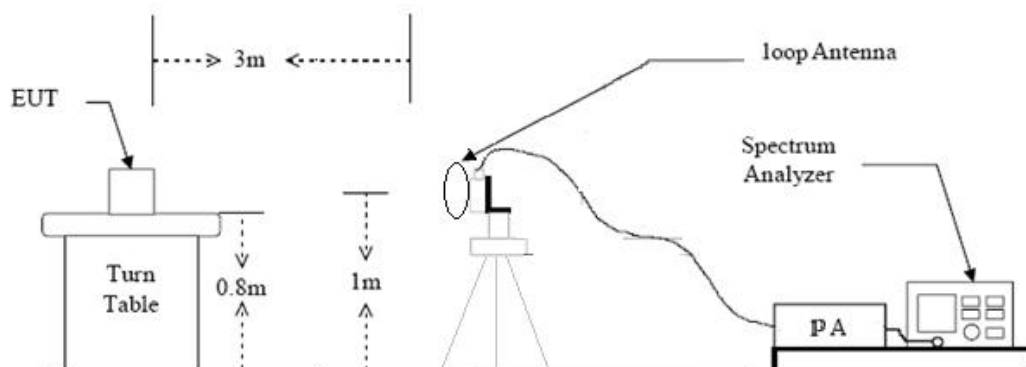


Diagram 4 of Configuration for Testing Radiated Emission below 30MHz



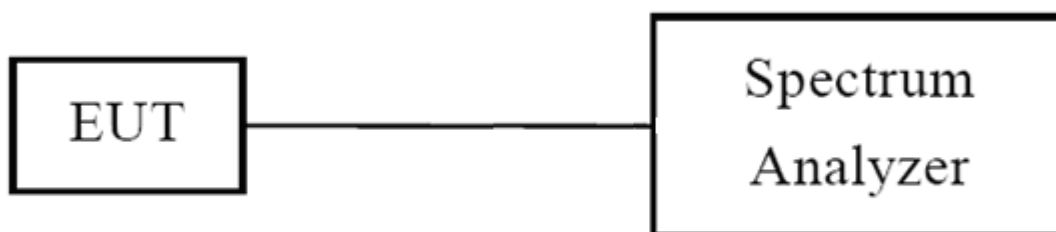
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Diagram 5 of Configuration for Testing other test items



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5 Test Results EMISSION

5.1 Conducted Emission

RESULT:

Pass

Date of testing	:	Aug.09,2011
Test specification	:	FCC Part 15 Per Section 15.207(a)
Limits	:	FCC Part 15 Per Section 15.207(a)
Test procedure	:	Procedure specified in ANSI C63.4 were followed
Deviations from Standard Test Procedures		
Procedures	:	None
Kind of test site	:	Shielded room
Operation mode	:	Charging
Power supply	:	AC120V/60Hz
Temperature	:	22°C
Humidity	:	50%

Test procedure:

1. Place the EUT as specified in ANSI C63.4 Clause 7.2.1
2. Plug the LISN to a correct power source (pay attention to: AC/DC, voltage, frequency).
4. Connect the EUT to LISN and choose N or L1 on the LISN.
5. Connect measurement receiver and LISN with a 50-ohm coaxial cable and a pulse limiter then begin exploratory measurement as specified in ANSI C63.4 Clause 7.2.3
6. Make final measurement as specified in ANSI C63.4 Clause 7.2.4
7. Switch to the other line on the LISN and repeat step 4 to 6.

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*) Measurement is made from 150 kHz to 30 MHz. Disturbances other than those mentioned above are small or not detectable.

If the result of the measurement with the Quasi Peak detector is below the Average limit, the measurement with Average Detector may be omitted.

Refer to the attached appendix 1 for detail result.

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5.2 Radiated Spurious Emission

RESULT:

Pass

Date of testing	:	Aug.11,2011
Test specification	:	FCC Part 15 Per Section 15.209(a)
Limits	:	FCC Part 15 Per Section 15.209(a)
Test procedure	:	Procedure specified in ANSI C63.4
Deviations from Standard Test procedures	:	None
Kind of test site	:	3m Semi-anechoic chamber
Operation mode	:	RF transmitting at fix channel with max power (High, Low, Mid)
Power supply	:	AC120V/60Hz
Temperature	:	23°C
Humidity	:	50%

Test procedure:

1. The EUT was placed on the top of a rotatable table 0.8 meters above the ground with 3-orthogonal direction and be kept close enough to the receiving antenna. The table was rotated 360 degrees to determine the suspected emission frequency and the position of the worst radiation case with both horizontal and vertical antenna polarization.

2. The EUT was then set 3 meters away from the receiving antenna, which was mounted on a variable-height antenna tower.

3. For each suspected emission frequency recorded in step 1, the EUT was arranged to its worst case and:

for tests below 30MHz the loop antenna is positioned with its plane vertical and the center of it is 1m above the ground. During the tests it is rotated about its vertical axis for maximum response at each azimuth about the EUT;

for tests above 30MHz the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to read the maximum emission.

Note:

While testing, the EUT is connected with a serial port bridge board for test mode setup. The length of the communication cable between the EUT and the bridge board, which including Tx, Rx, GND serial pins, is minimized to reduce the unwanted influence to test result. The bridge board can be connected to a host computer with standard DB9 com port cable for running of the test setup software. After setup successfully, the EUT can keep the test mode with the host computer and the cable removed.

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*) Note:

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz at frequency below 1GHz.

The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz at frequency above 1GHz.

Measurement is made from 9kHz to 25 GHz. Disturbances other than those mentioned above are small or not detectable.

Refer to the attached appendix 1 for detail result.

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5.3 Antenna requirement

RESULT:

Pass

Date of testing : ---

Test specification : FCC Part 15 Per Section 15.203
FCC Part 15 Per Section 15.247(b)

For intentional device, according to 15.203, and intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to 15.247(b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by amount in dB than the directional gain of the antenna exceeds of 6dBi.

As the BT antenna is permanently printed on RF Board, there is no consideration of replacement.

And the max gain of the antenna is 0dBi.

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5.4 Maximum Peak Output Power

RESULT:

Pass

Date of testing : Aug. 10, 2011
Test specification : FCC Part 15 Per Section 15.247(b)(1)
Limits : FCC Part 15 Per Section 15.247(b)(1)

For frequency hopping systems operating in the band 2400-2483.5 MHz employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W (21dBm).

Deviations from Standard Test procedures : None
Test procedure : Procedure specified in ANSI C63.4
Kind of test site : Shielded room
Operation mode : Transmitting on the measured channel.
Power supply : AC120V/60Hz
Temperature : 23°C
Humidity : 50%

Table 2: Peak Conducted Power

Channel	Frequency (MHz)	Power Reading(dBm)	Cable Loss (dB)	Output Power (dBm)	Limit * (dBm)
Low	2409.0	10.49	0.40	10.89	21
Mid	2441.0	9.86	0.40	10.26	21
High	2475.0	9.51	0.40	9.91	21
*Note: Refer to the test result of "Number of Hopping Channel Used" for the non-overlap channel number.					

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5.5 20dB Bandwidth

RESULT:

Pass

Date of testing : Aug. 10, 2011
Test specification : FCC Part 15 Per Section 15.247(a)(1)
Limits : FCC Part 15 Per Section 15.247(b)(1)

Frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125W.

Deviations from Standard Test procedures

: None
Test procedure : Procedure specified in ANSI C63.4
Operation mode : Transmitting on the measured channel.
Kind of test site : Shielded room
Power supply : AC120V/60Hz
Temperature : 23°C
Humidity : 50%

Test procedure:

1. Connect the antenna port of the EUT to the spectrum analyzer by a low lost cable.
2. Set the EUT to proper test mode with relative test software and hardware.
3. Spectrum analyzer setting: Centered Frequency= measured channel, RBW=10kHz, VBW=30kHz.
4. Mark the peak power frequency point and the -20dB upper and lower frequency points.
5. Read the frequency delta value between the -20dB upper and lower frequency points.
6. Repeat step 2 to 5 until all the channels required are finished.

Table 3: 20dB Bandwidth

Channel	Frequency (GHz)	Test Result (kHz)
Low	2409.0	1490
Mid	2441.0	1580
High	2475.0	1600

Refer to the attached appendix 1 for detail result.

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5.6 Hopping Channel Carrier Frequency Separation

RESULT:

Pass

Date of testing	:	Aug. 10, 2011
Test specification	:	FCC Part 15 Per Section 15.247(a)(1)
Limits	:	FCC Part 15 Per Section 15.247(a)(1)

Frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125W.

Deviations from Standard Test

procedures	:	None
Test procedure	:	Procedure specified in ANSI C63.4
Kind of test site	:	Shielded room
Operation mode	:	Transmitting with hopping at the full channel set
Power supply	:	AC120V/60Hz
Temperature	:	23°C
Humidity	:	50%

Test procedure:

1. Connect the antenna port of the EUT to the spectrum analyzer by a low loss cable.
2. Set the EUT to proper test mode with relative test software and hardware.
3. Spectrum analyzer setting: Centered Frequency = measured channel, RBW = 30 kHz, VBW = 100 kHz, Frequency Span = wide enough to cover the adjacent channel.
4. Mark the peak power frequency point of the measured channel and its adjacent channel(s)
5. Read the frequency delta value between the measured channel and its adjacent channel(s)
6. Repeat step 3 to 5 until all the channels measured are finished.

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Table 4: Hopping Channel Carrier Frequency Separation

Channel	Adjacent Hopping channel separation (kHz)	Limit
Low	2060	At least 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater. Note: refer to Table 3 for the value of 20dB bandwidth
Mid	1976	
High	1990	

Refer to the attached appendix 1 for detail result.

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5.7 Number of Hopping Frequency Used

RESULT:

Pass

Date of testing	:	Aug.10, 2011
Test specification	:	FCC Part 15 Per Section 15.247(a)(1)(iii)
Limits	:	FCC Part 15 Per Section 15.247(a)(1)(iii) Frequency hopping system in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels
Deviations from Standard Test procedures	:	None
Test procedure	:	Procedure specified in ANSI C63.4
Kind of test site	:	Shielded room
Operation mode	:	Transmitting with hopping at the full channel set
Power supply	:	AC120V/60Hz
Temperature	:	23°C
Humidity	:	50%

Test procedure:

1. Connect the antenna port of the EUT to the spectrum analyzer by a low loss cable.
2. Set the EUT to proper test mode with relative test software and hardware.
3. Spectrum analyzer setting: RBW = 100 kHz, VBW ≥ RBW, Frequency Span = wide enough to cover the channels to be plotted.
4. Set the spectrum analyzer to Max-hold mode and plot the result(s) with record of all hopping channel.

Table 5: Number of hopping frequency

Number of hopping frequency:	28
Limit:	At least 15 non-overlapping channels

Refer to the attached appendix 1 for detail result.

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5.8 Time of Occupancy (Dwell Time)

RESULT:

Pass

Date of testing	:	Aug.10, 2011
Test specification	:	FCC Part 15 Per Section 15.247(a)(1)(iii)
Limits	:	FCC Part 15 Per Section 15.247(a)(1)(iii)

For frequency hopping system operating in the 2400-2483.5MHz band, 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 channels employed.

Deviations from Standard Test procedures	:	None
Test Procedure	:	Procedure specified in ANSI C63.4
Kind of test site	:	Shielded room
Operation mode	:	Transmitting with hopping at the full channel set
Power supply	:	AC120V/60Hz
Temperature	:	23°C
Humidity	:	50%

Test procedure:

1. Connect the antenna port of the EUT to the spectrum analyzer by a low loss cable.
2. Set the EUT to proper test mode with relative test software and hardware.
3. Spectrum analyzer setting: Centered Frequency = measured channel, RBW = 1MHz, VBW \geq RBW, Frequency Span = 0 Hz.
4. Set sweep time properly to capture the entire dwell time per hopping channel.
5. Set detector type to Peak and trace mode to Max Hold and make the measurement.
6. Repeat step 3-5 until all channels measured were complete.

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Table 6: Dwell Time

channel	Frequency (GHz)	Dwell time of one signal Burst (ms)	Total Dwell Time (ms)	Limit (ms)
Low	2409.0	0.392	$(0.392 \times 51 \times 11.2) = 224$	400
Mid	2441.0	0.392	$(0.392 \times 51 \times 11.2) = 224$	400
High	2475.0	0.330	$(0.330 \times 51 \times 11.2) = 189$	400

Note :

Period = 0.4 (seconds) x 28 (channels) = 11.2 seconds

There are 1428 hopping times in one second. In one period for each particular channel there are $1428 / 28 = 51$ times of transmission.

Dwell Time in one period(ms) = Dwell time of one-slot transmission(ms) multiplexes **51**.

Refer to the attached appendix 1 for detail result.

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5.9 Out-of-Band Emission

RESULT:

Pass

Date of testing : Aug. 11, 2011
Test specification : FCC Part 15 Per Section 15.247(d)
Limits : FCC Part 15 Per Section 15.247(d)

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

In addition:

FCC Part 15 - radiated emission which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

Deviations from Standard Test procedures

: None
Test Procedure : Procedure specified in ANSI C63.4
Kind of test site : Shielded room
Operation mode : Transmitting at the highest and lowest channel (band edge)
Power supply : AC120V/60Hz
Temperature : 23°C
Humidity : 50%

Test procedure:

1. Connect the antenna port of the EUT to the spectrum analyzer by a low lost cable.
2. Set the EUT to proper test mode with relative test software and hardware.
3. Spectrum analyzer setting: RBW = 100 kHz, VBW≥RBW.
4. Set proper frequency span respectively for out-of-band emission measurement of the band edge and the whole range (up to 10 times of the carrier frequency.)
5. Set the trace mode to Max Hold and mark the peak reading of any spurious emission recorded.

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Table 7: Out-Of-Band Emission measurement (conducted)

Emission (Carrier operating at Channel low, mid and high)	Attenuation	Limit (dB)
30MHz to 25GHz	All emission in this 100kHz bandwidth are attenuated more than 20dB from the carrier	$\Delta \geq 20$

Note: Refer to the attached appendix 1 for detail result.

Table 8: Band Edges Emission in the Restricted Bands by Marker Delta Method

Frequency [MHz]	dBc [dB]	PK [dB μ V/m]	AV [dB μ V/m]	Polarity (H/V)	PK limit [dB μ V/m]	AV limit [dB μ V/m]
2474.8	50.65	34.28	---	H	74	54
2335.0	59.58	24.65	---	H	74	54

NOTE:

1. The Peak carrier field strength of the highest/lowest channel is 84.93dBuV/m, 84.23dBuV/m.
The above field strength levels were measured in horizontal polarity which is the worst case.
2. The dBc value between the carrier maximum power and band edge emission power of the frequency listed in the table is calculated from the test record showed in Appendix 1.
3. Peak value of the high/low band edge emission listed in the table is calculated by the below formula: PK value of band edge emission = Peak carrier field strength – dBc value in item2

*Note: Please refer to Appendix 1 for measurement data. Disturbances other than those mentioned above are small or not detectable. Please refer to the Appendix 1 for the noise floor of the band edge emission.

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6 Photographs of the Test Set-Up

Photograph 1: Set-up for Conducted Emission



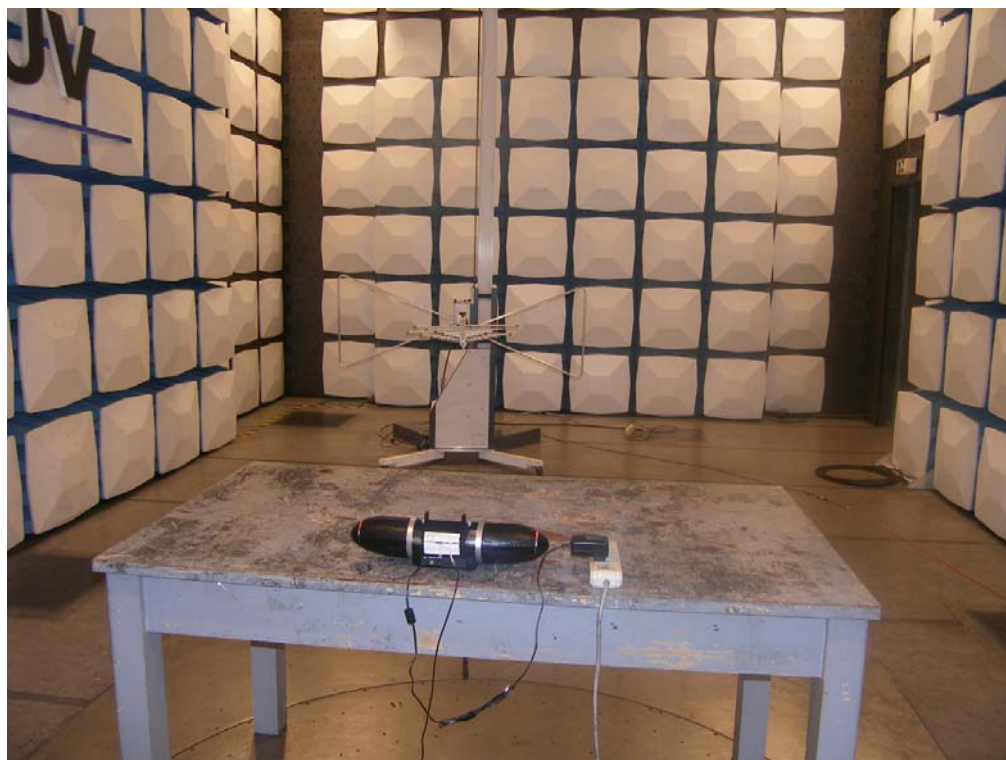
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Photograph 2: Set-up for Radiation Measurement below 1GHz



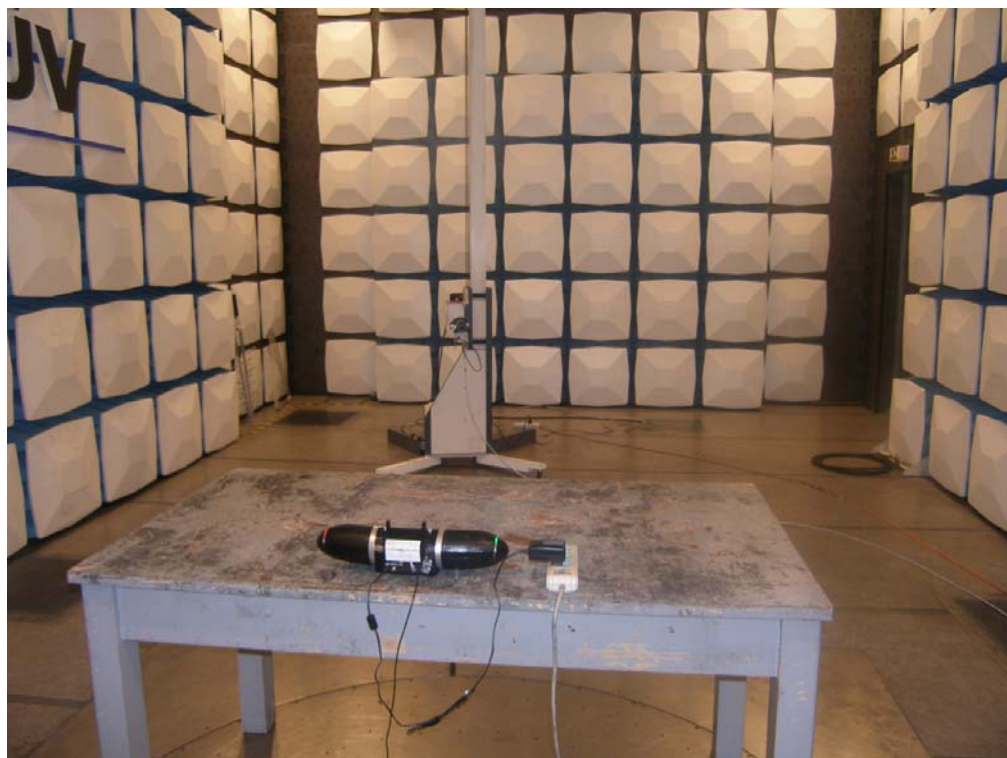
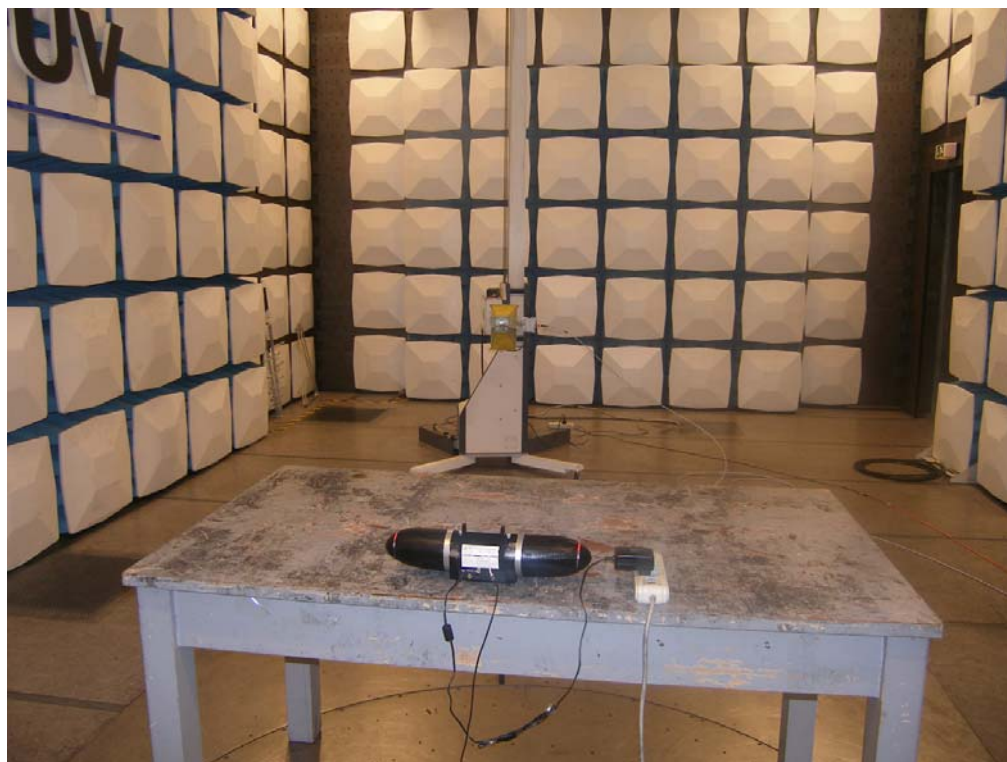
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Photograph 3: Set-up for Radiation Measurement above 1GHz



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