SPORTON International Inc.
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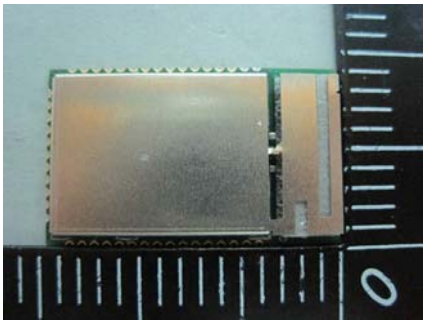
FCC RADIO TEST REPORT

Applicant's company	**Joymax Electronics Co., Ltd.**
Applicant Address	**No. 5, Dong Yuan Rd. 2, Jhongli Industrial Park, Jhongli City, Tao Yuan 32063 Taiwan, R.O.C.**
FCC ID	**XNNMD120AC**
Manufacturer's company	**Joymax Electronics Co., Ltd.**
Manufacturer Address	**No. 5, Dong Yuan Rd. 2, Jhongli Industrial Park, Jhongli City, Tao Yuan 32063 Taiwan, R.O.C.**

Product Name	**2.4GHz ZigBee Wireless Module**
Brand Name	**Joymax**
Model Name	**MD-120AC**
Test Rule	**47 CFR FCC Part 15 Subpart C § 15.247**
Test Freq. Range	**2405~ 2475MHz**
Received Date	**Mar. 21, 2012**
Final Test Date	**Apr. 12, 2012**
Submission Type	**Original Equipment**



Statement

Test result included is only for the IEEE 802.15.4 ZigBee part of the product.

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in **ANSI C63.10-2009** and **47 CFR FCC Part 15 Subpart C**.

The test equipment used to perform the test is calibrated and traceable to NML/ROC.

Testing Laboratory
1190

Table of Contents

History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR232114	Rev. 01	Initial issue of report	Apr. 25, 2012

Certificate No.: CB10104055

1. CERTIFICATE OF COMPLIANCE

Product Name	:	**2.4GHz ZigBee Wireless Module**
Brand Name	:	**Joymax**
Model Name	:	**MD-120AC**
Applicant	:	**Joymax Electronics Co., Ltd.**
Test Rule Part(s)	:	**47 CFR FCC Part 15 Subpart C § 15.247**

Sporton International as requested by the applicant to evaluate the EMC performance of the product sample received on **Mar. 21, 2012** would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.

Jordan Hsiao

Jordan Hsiao

SPORTON INTERNATIONAL INC.

2. SUMMARY OF THE TEST RESULT

Applied Standard: 47 CFR FCC Part 15 Subpart C				
Part	**Rule Section**	**Description of Test**	**Result**	**Under Limit**
4.1	15.207	AC Power Line Conducted Emissions	Complies	12.07 dB
4.2	15.247(b)(3)	Peak Output Power	Complies	11.75 dB
4.3	15.247(e)	Power Spectral Density	Complies	8.84dB
4.4	15.247(a)(2)	6dB Spectrum Bandwidth	Complies	-
4.5	15.247(d)	Radiated Emissions	Complies	4.16 dB
4.6	15.247(d)	Band Edge Emissions	Complies	1.16dB
4.7	15.203	Antenna Requirements	Complies	-

Test Items	Uncertainty	Remark
AC Power Line Conducted Emissions	±2.3dB	Confidence levels of 95%
Maximum Conducted Output Power	±0.8dB	Confidence levels of 95%
Power Spectral Density	±0.5dB	Confidence levels of 95%
6dB Spectrum Bandwidth	$\pm 8.5\times10^{-8}$	Confidence levels of 95%
Radiated Emissions (9kHz~30MHz)	±0.8dB	Confidence levels of 95%
Radiated Emissions (30MHz~1000MHz)	±1.9dB	Confidence levels of 95%
Radiated / Band Edge Emissions (1GHz~18GHz)	±1.9dB	Confidence levels of 95%
Radiated Emissions (18GHz~40GHz)	±1.9dB	Confidence levels of 95%
Temperature	±0.7℃	Confidence levels of 95%
Humidity	±3.2%	Confidence levels of 95%
DC / AC Power Source	±1.4%	Confidence levels of 95%

3. GENERAL INFORMATION

3.1. Product Details

Items	Description
Power Type	From host system
Modulation	DSSS (O-QPSK)
Data Rate (Mbps)	DSSS (250kbps)
Frequency Range	2405～ 2475MHz
Channel Number	15
Channel Band Width (99%)	2.32 MHz
Conducted Output Power	18.26 dBm
Carrier Frequencies	Please refer to section 3.4
Antenna	Please refer to section 3.3

3.2. Accessories

N/A

3.3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	Joymax	MD-120AC-5148A	PIFA Antenna	NA	3.5

3.4. Table for Carrier Frequencies

Frequency Band	Channel No.	Frequency	Channel No.	Frequency
2405 ～ 2475MHz	11	2405 MHz	19	2445 MHz
	12	2410 MHz	20	2450 MHz
	13	2415 MHz	21	2455 MHz
	14	2420 MHz	22	2460 MHz
	15	2425 MHz	23	2465 MHz
	16	2430 MHz	24	2470 MHz
	17	2435 MHz	25	2475 MHz
	18	2440 MHz	-	-

3.5. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Channel	Antenna
AC Power Line Conducted Emissions	Normal Link	-	-	-
Peak Output Power	TX Mode	250 kbps	11/18/25	-
Power Spectral Density 6dB Spectrum Bandwidth	TX Mode	250 kbps	11/18/25	-
Radiated Emissions 9kHz~1GHz	Normal Link	-	-	-
Radiated Emissions 1GHz~10th Harmonic	TX Mode	250 kbps	11/18/25	1
Band Edge Emissions	TX Mode	250 kbps	11/25	1

3.6. Table for Testing Locations

Test Site No.	Site Category	Location	FCC Reg. No.	IC File No.	VCCI Reg. No
03CH01-CB	SAC	Hsin Chu	187376	IC 4086D	-
CO01-CB	Conduction	Hsin Chu	187376	IC 4086D	-
TH01-CB	OVEN Room	Hsin Chu	-	-	-

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC); Fully Anechoic Chamber (FAC).

Please refer section 6 for Test Site Address.

3.7. Table for Supporting Units

Support Unit	Brand	Model	FCC ID
Notebook	DELL	1340	E2K4965AGNM
Notebook	DELL	D420	E2KWM3945ABG
Notebook	DELL	D400	E2K24GBRL
EARPHONES	E-books	E-EPC040	-
MD-100AB	Shi-Yi	-	-
Master	Shi-Yi	-	-

3.8. Table for Parameters of Test Software Setting

During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Power Parameters of IEEE 802.15.4 ZigBee

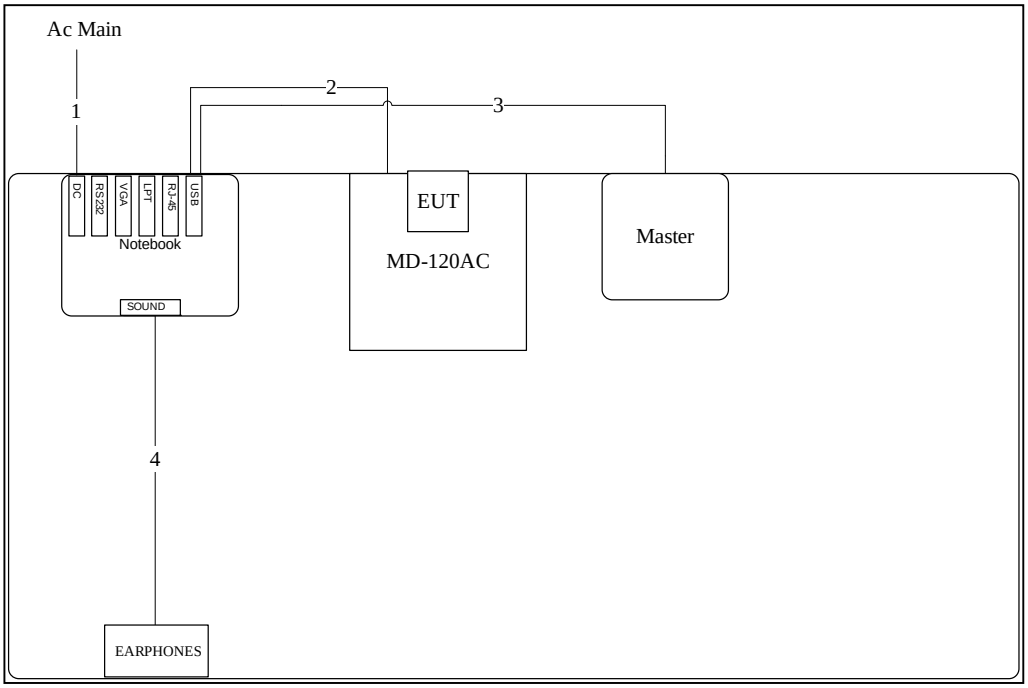
Test Software Version	Hyperterminal		
Frequency	2405 MHz	2440 MHz	2475 MHz
IIEEE 802.11b DSSS	3	3	3

Executed "Hyperterminal" was executed the test program to control the EUT continuously transmit RF signal.

3.9. Test Configurations

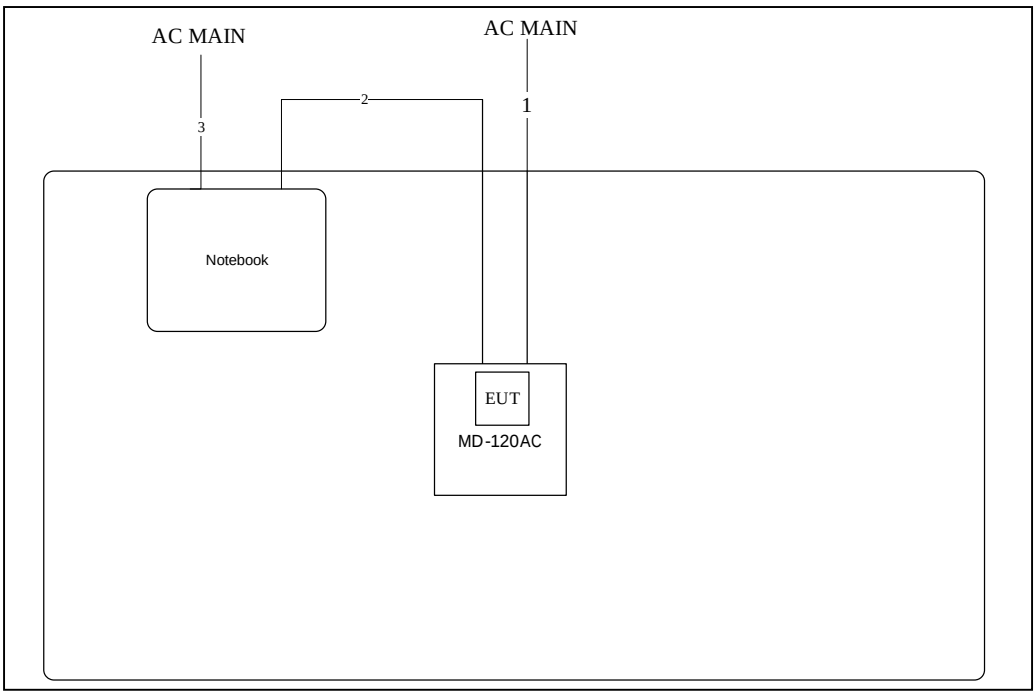
3.9.1. Radiation Emissions Test Configuration

Test Configuration: 30MHz~1GHz



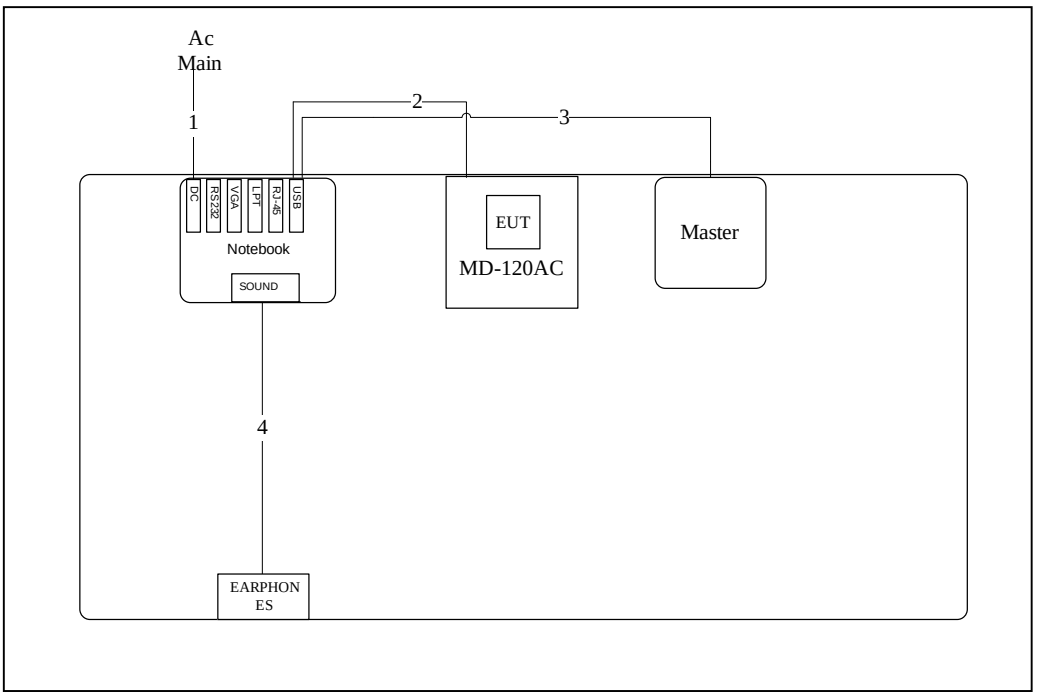
Item	Connection	Shield	Length
1	Power Cable	No	2.6M
2	USB Cable	Yes	1.75M
3	USB Cable	Yes	1.75M
4	Earphone Cable	No	1.1M

Test Configuration: Above 1GHz



Item	Connection	Shield	Length
1	Power Cable	No	1.5M
2	USB Cable	Yes	1.75M
3	Power Cable	No	2.6M

3.9.2. AC Power Line Conduction Emissions Test Configuration



Item	Connection	Shield	Length
1	Power Cable	No	2.6M
2	USB Cable	Yes	1.75M
3	USB Cable	Yes	1.75M
4	Earphone Cable	No	1.1M

4. TEST RESULT

4.1. AC Power Line Conducted Emissions Measurement

4.1.1. Limit

For a Low-power Radio-frequency Device which is designed to be connected to the AC power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed below limits table.

Frequency (MHz)	QP Limit (dBuV)	AV Limit (dBuV)
0.15~0.5	66~56	56~46
0.5~5	56	46
5~30	60	50

4.1.2. Measuring Instruments and Setting

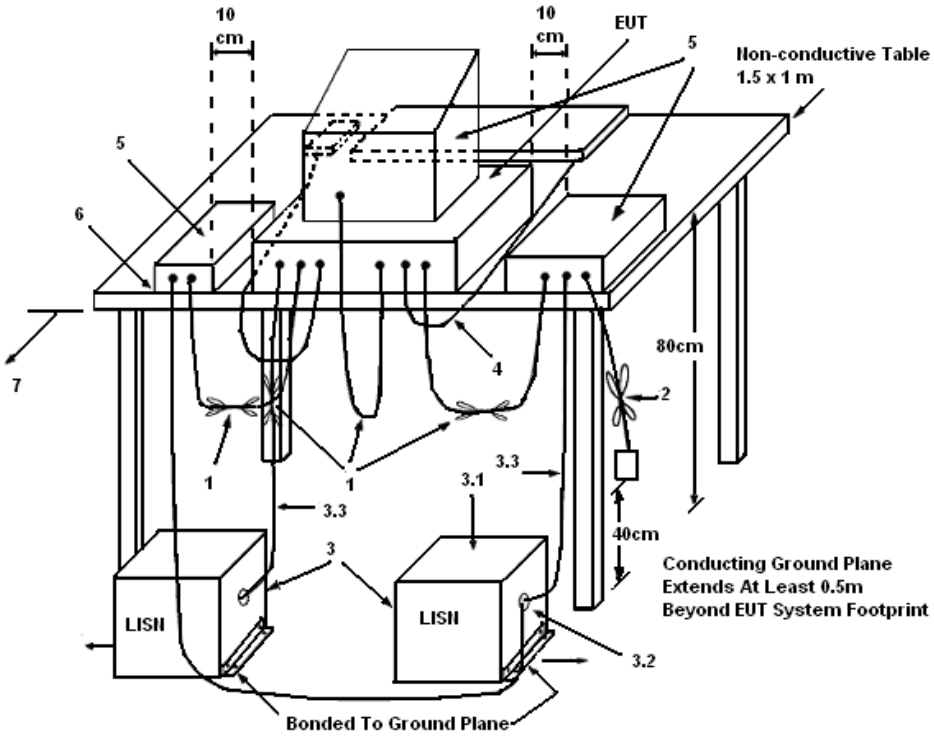
Please refer to section 5 of equipments list in this report. The following table is the setting of the receiver.

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 KHz

4.1.3. Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT or host of EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connected to the other LISNs. The LISN should provide 50uH/50ohms coupling impedance.
4. The frequency range from 150 KHz to 30 MHz was searched.
5. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. The measurement has to be done between each power line and ground at the power terminal.

4.1.4. Test Setup Layout



LEGEND:

(1) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

(2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

(3) EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, reference ground plane.

(3.1) All other equipment powered from additional LISN(s).

(3.2) Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

(3.3) LISN at least 80 cm from nearest part of EUT chassis.

(4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

(5) Non-EUT components of EUT system being tested.

(6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

(7) Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.

4.1.5. Test Deviation

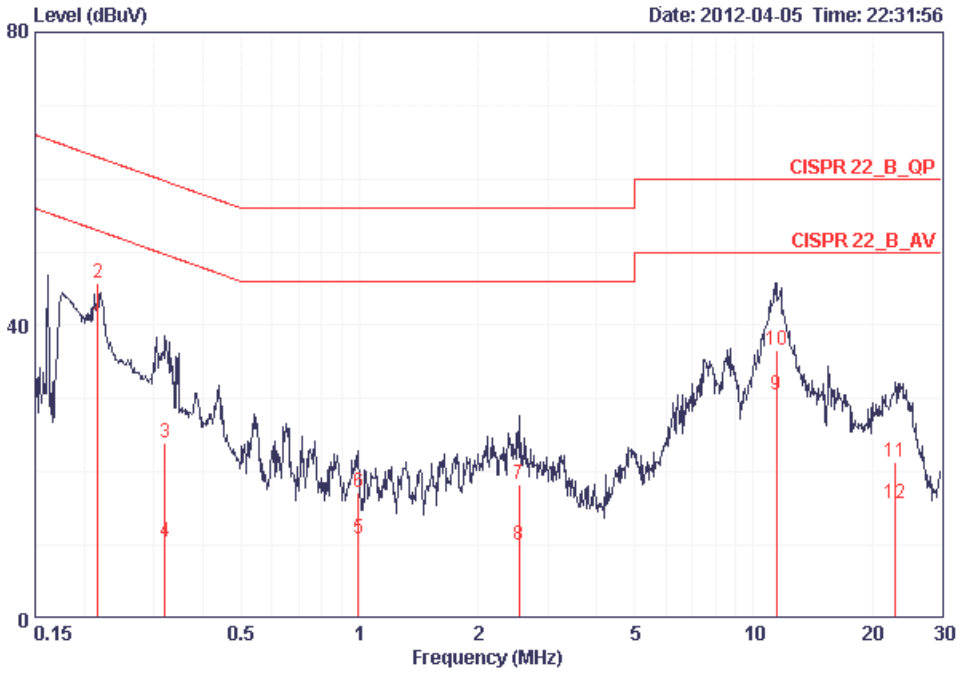
There is no deviation with the original standard.

4.1.6. EUT Operation during Test

The EUT was placed on the test table and programmed in normal function.

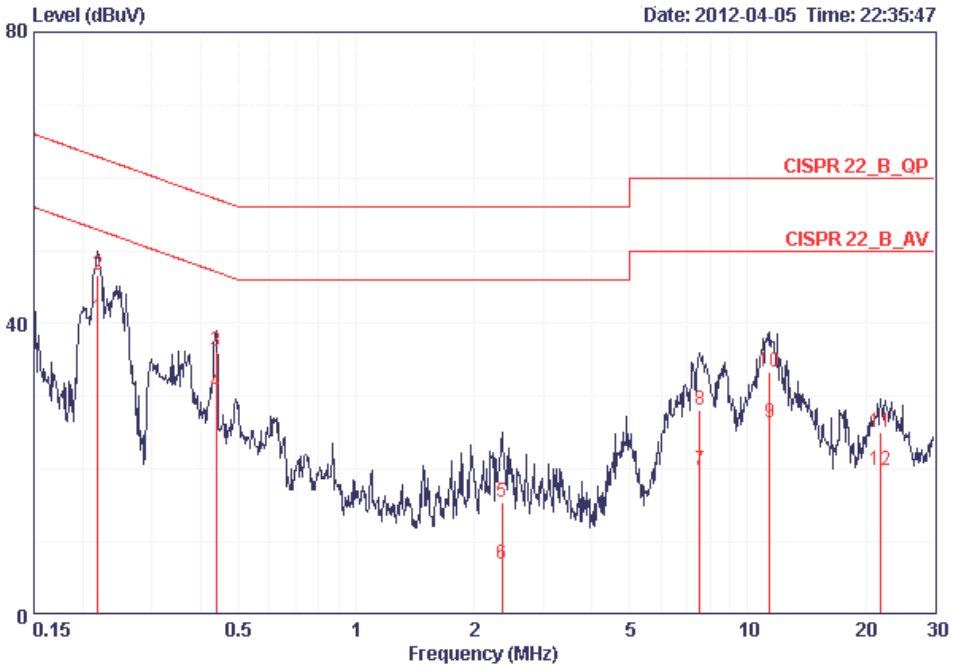
4.1.7. Results of AC Power Line Conducted Emissions Measurement

Temperature	21℃	Humidity	63%
Test Engineer	Ryo Fan	Phase	Line
Configuration	Normal Link		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.21620	40.22	-12.75	52.96	39.97	0.05	0.20	AVERAGE
2	0.21620	45.71	-17.26	62.96	45.46	0.05	0.20	QP
3	0.31999	24.07	-35.64	59.71	23.83	0.04	0.20	QP
4	0.31999	10.38	-39.33	49.71	10.14	0.04	0.20	AVERAGE
5	0.99440	10.83	-35.17	46.00	10.60	0.03	0.20	AVERAGE
6	0.99440	17.13	-38.87	56.00	16.90	0.03	0.20	QP
7	2.540	18.27	-37.73	56.00	18.00	0.07	0.20	QP
8	2.540	10.08	-35.92	46.00	9.81	0.07	0.20	AVERAGE
9	11.438	30.51	-19.49	50.00	29.69	0.42	0.40	AVERAGE
10	11.438	36.71	-23.29	60.00	35.89	0.42	0.40	QP
11	22.896	21.38	-38.62	60.00	19.87	1.01	0.50	QP
12	22.896	15.79	-34.21	50.00	14.28	1.01	0.50	AVERAGE

Temperature	21°C	Humidity	63%
Test Engineer	Ryo Fan	Phase	Neutral
Configuration	Normal Link		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1 @	0.21851	40.81	-12.07	52.88	40.53	0.08	0.20	AVERAGE
2	0.21851	46.71	-16.17	62.88	46.43	0.08	0.20	QP
3	0.43742	36.27	-20.84	57.11	36.00	0.07	0.20	QP
4	0.43742	30.51	-16.60	47.11	30.24	0.07	0.20	AVERAGE
5	2.358	15.47	-40.53	56.00	15.17	0.10	0.20	QP
6	2.358	6.91	-39.09	46.00	6.61	0.10	0.20	AVERAGE
7	7.526	19.93	-30.07	50.00	19.22	0.31	0.40	AVERAGE
8	7.526	28.16	-31.84	60.00	27.45	0.31	0.40	QP
9	11.377	26.37	-23.63	50.00	25.52	0.45	0.40	AVERAGE
10	11.377	33.34	-26.66	60.00	32.49	0.45	0.40	QP
11	21.830	25.12	-34.88	60.00	23.67	0.95	0.50	QP
12	21.830	19.86	-30.14	50.00	18.41	0.95	0.50	AVERAGE

Note:

Level = Read Level + LISN Factor + Cable Loss.

4.2. Peak Output Power Measurement

4.2.1. Limit

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. The limited has to be reduced by the amount in dB that the gain of the antenna exceed 6dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

4.2.2. Measuring Instruments and Setting

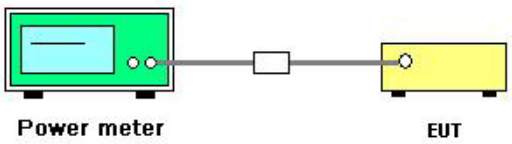
Please refer to section 5 of equipments list in this report. The following table is the setting of the peak power meter.

Power Meter Parameter	Setting
Bandwidth	50MHz bandwidth is greater than the EUT emission bandwidth
Detector	Peak

4.2.3. Test Procedures

Spectrum Parameter	Setting
RF Output Power Method	☒ ANSI C63.10 clause 6.10.2.1 (a) power meter method
RF Output Power Method	☐ ANSI C63.10 clause 6.10.2.1 (b) channel integration method
RF Output Power Method	☐ ANSI C63.10 clause 6.10.3.1 Method 1 - spectral trace averaging
RF Output Power Method	☐ ANSI C63.10 clause 6.10.3.2 Method 2 - zero-span mode with trace averaging

4.2.4. Test Setup Layout



4.2.5. Test Deviation

There is no deviation with the original standard.

4.2.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.2.7. Test Result of Peak Output Power

Temperature	23°C	Humidity	62%
Test Engineer	Sean Ku	Configurations	802.15.4 Zigbee
Test Date	Apr. 09, 2012		

Configuration IEEE 802.15.4 Zigbee

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
11	2405 MHz	18.23	30.00	Complies
18	2440 MHz	18.26	30.00	Complies
25	2475 MHz	18.25	30.00	Complies

4.3. Power Spectral Density Measurement

4.3.1. Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.3.2. Measuring Instruments and Setting

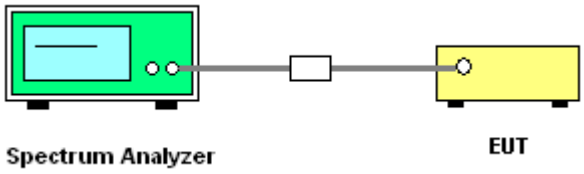
Please refer to section 5 of equipments list in this report. The following table is the setting of Spectrum Analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	30 kHz
RB	3 kHz
VB	30 kHz
Detector	Peak

4.3.3. Test Procedures

Spectrum Parameter	Setting
Power Density Method	☒ UNII for ANSI C63.10 clause 6.11.2.3 Method 1 - peak measurement
Power Density Method	☐ UNII for ANSI C63.10 clause 6.11.2.4 Method 2 - trace averaging

4.3.4. Test Setup Layout



4.3.5. Test Deviation

There is no deviation with the original standard.

4.3.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.3.7. Test Result of Power Spectral Density

Temperature	23°C	Humidity	62%
Test Engineer	Sean Ku	Configurations	802.15.4 Zigbee

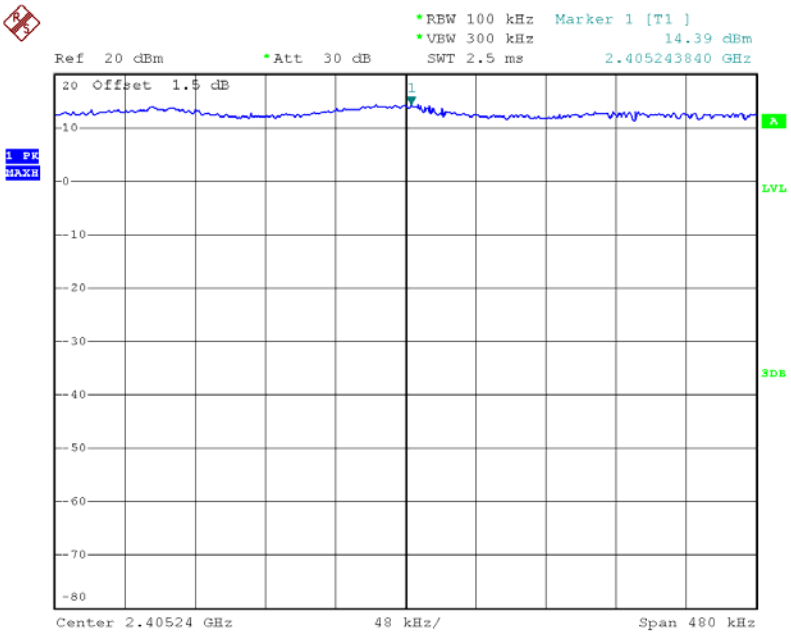
Configuration IEEE 802.15.4 Zigbee

Frequency	Power Density (dBm/100kHz)	Total Power Density (dBm/100kHz)	BWCF factor (100KHz to 3KHz)	Power Density (dBm/3kHz)	Max. Limit (dBm/3kHz)	Result
	ANT 1					
2405 MHz	14.39	14.39	-15.23	-0.84	8.00	Complies
2440 MHz	14.18	14.18	-15.23	-1.05	8.00	Complies
2475 MHz	14.28	14.28	-15.23	-0.95	8.00	Complies

Note: All the test values were listed in the report.

For plots, only the channel with maximum results was shown.

Power Density Plot on Configuration 802.15.4 Zigbee / 2405 MHz



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4.4. 6dB Spectrum Bandwidth Measurement

4.4.1. Limit

For digital modulation systems, the minimum 6dB bandwidth shall be at least 500 kHz.

4.4.2. Measuring Instruments and Setting

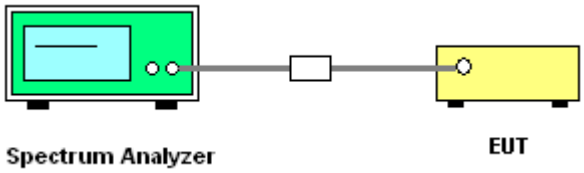
Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> 6dB Bandwidth
RB	100 kHz
VB	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

4.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth of 100 kHz and the video bandwidth of 100 kHz were used.
3. Measured the spectrum width with power higher than 6dB below carrier.

4.4.4. Test Setup Layout



4.4.5. Test Deviation

There is no deviation with the original standard.

4.4.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.4.7. Test Result of 6dB Spectrum Bandwidth

Temperature	23°C	Humidity	62%
Test Engineer	Sean Chang	Configurations	802.15.4 Zigbee

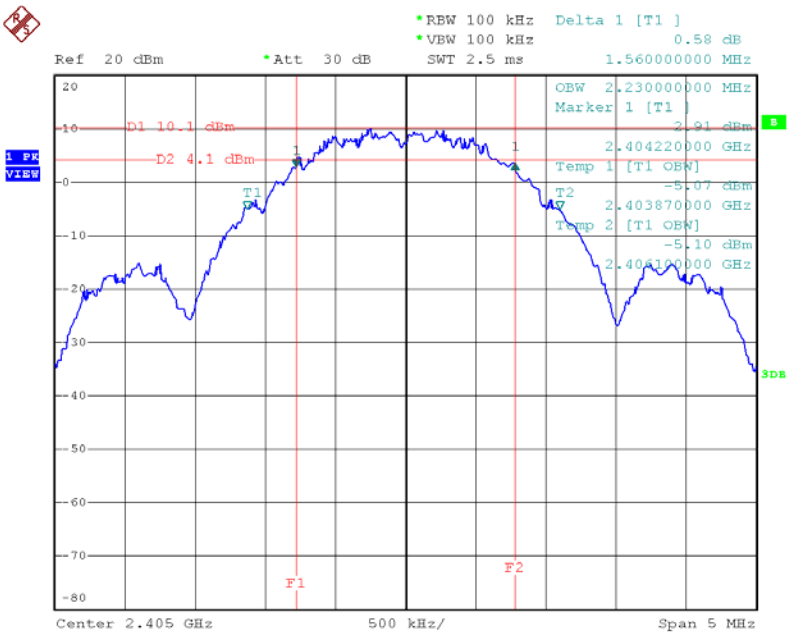
Configuration 802.15.4 Zigbee

Channel	Frequency	6dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Min. Limit (kHz)	Test Result
11	2405 MHz	1.56	2.23	500.00	Complies
18	2440 MHz	1.56	2.28	500.00	Complies
25	2475 MHz	1.60	2.32	500.00	Complies

Note: All the test values were listed in the report.

For plots, only the channel with maximum results was shown.

6 dB Bandwidth Plot on Configuration 802.15.4 Zigbee / 2405 MHz



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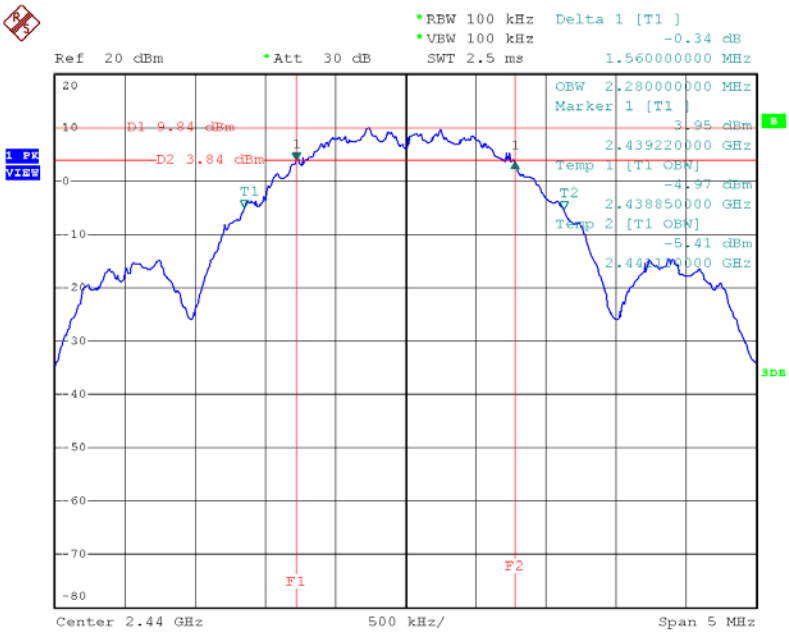
6 dB Bandwidth Plot on Configuration 802.15.4 Zigbee / 2440 MHz



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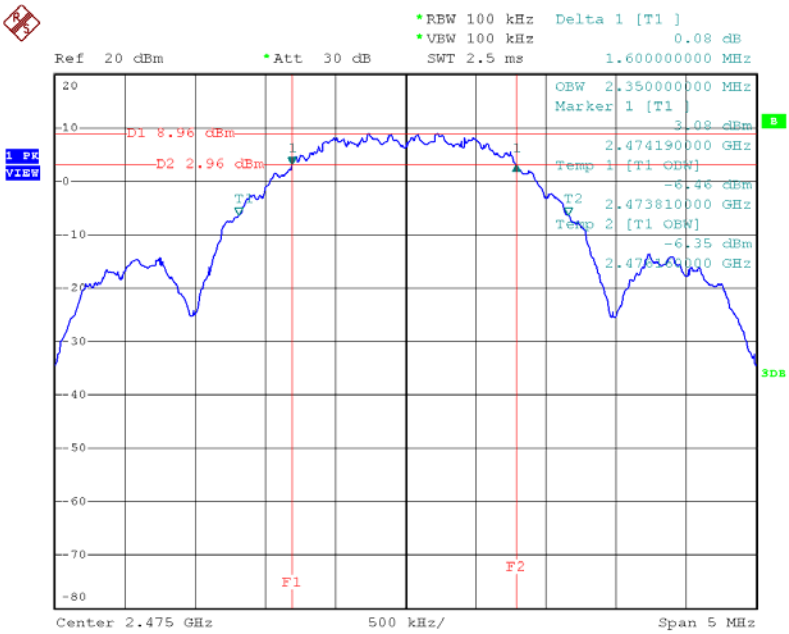
6 dB Bandwidth Plot on Configuration 802.15.4 Zigbee / 2475 MHz



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4.5. Radiated Emissions Measurement

4.5.1. Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

4.5.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 3 MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (Emission in non-restricted band)	1MHz / 3 MHz for peak

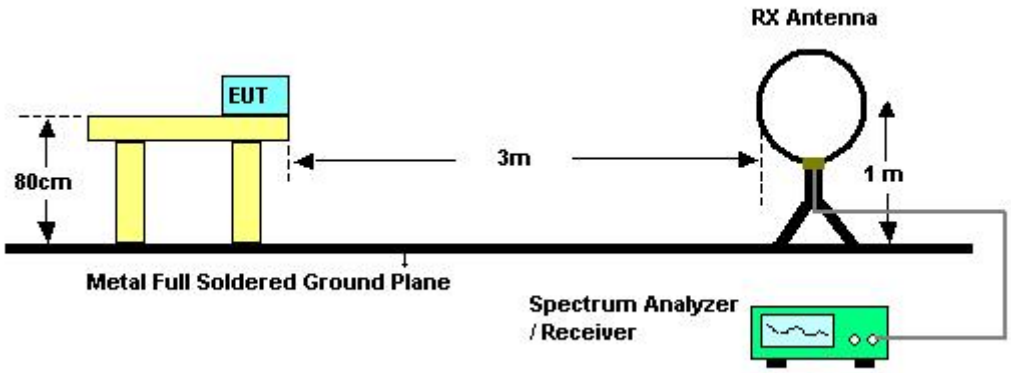
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

4.5.3. Test Procedures

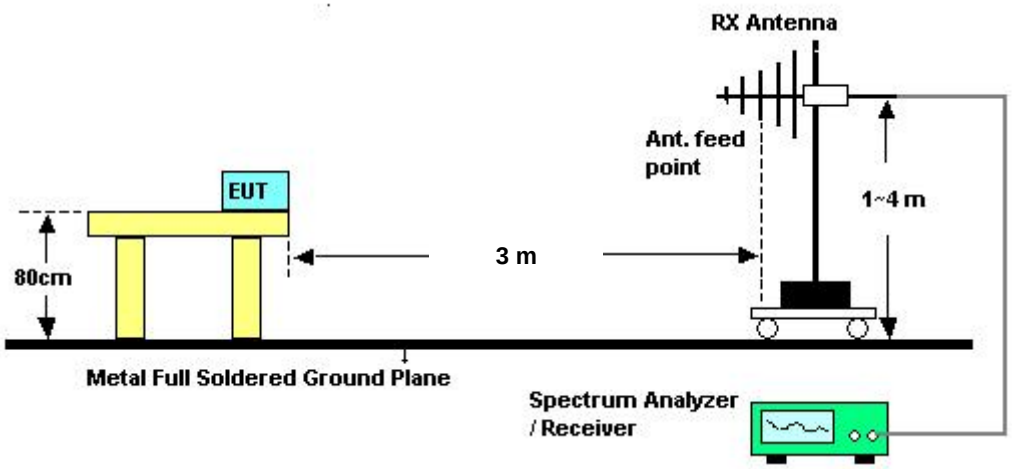
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

4.5.4. Test Setup Layout

For radiated emissions below 1GHz



For radiated emissions above 1GHz



4.5.5. Test Deviation

There is no deviation with the original standard.

4.5.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.5.7. Results of Radiated Emissions (9kHz~30MHz)

Temperature	23°C	Humidity	58%
Test Engineer	Wen Chao	Test Date	Apr. 06, 2012

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

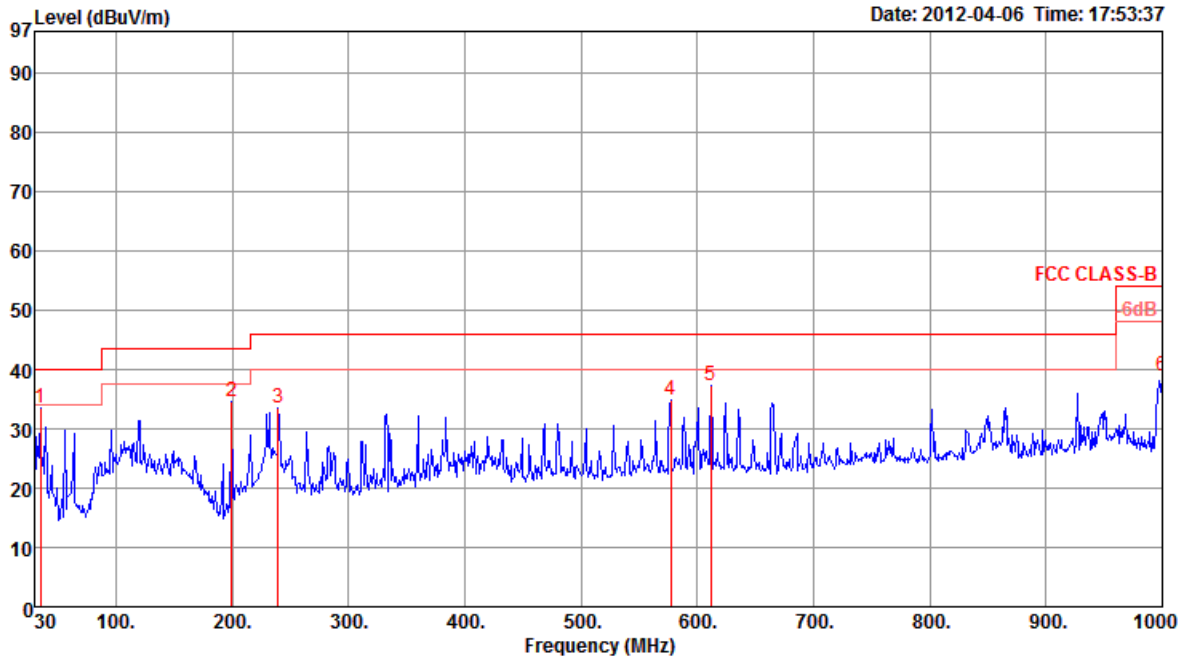
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

4.5.8. Results of Radiated Emissions (30MHz~1GHz)

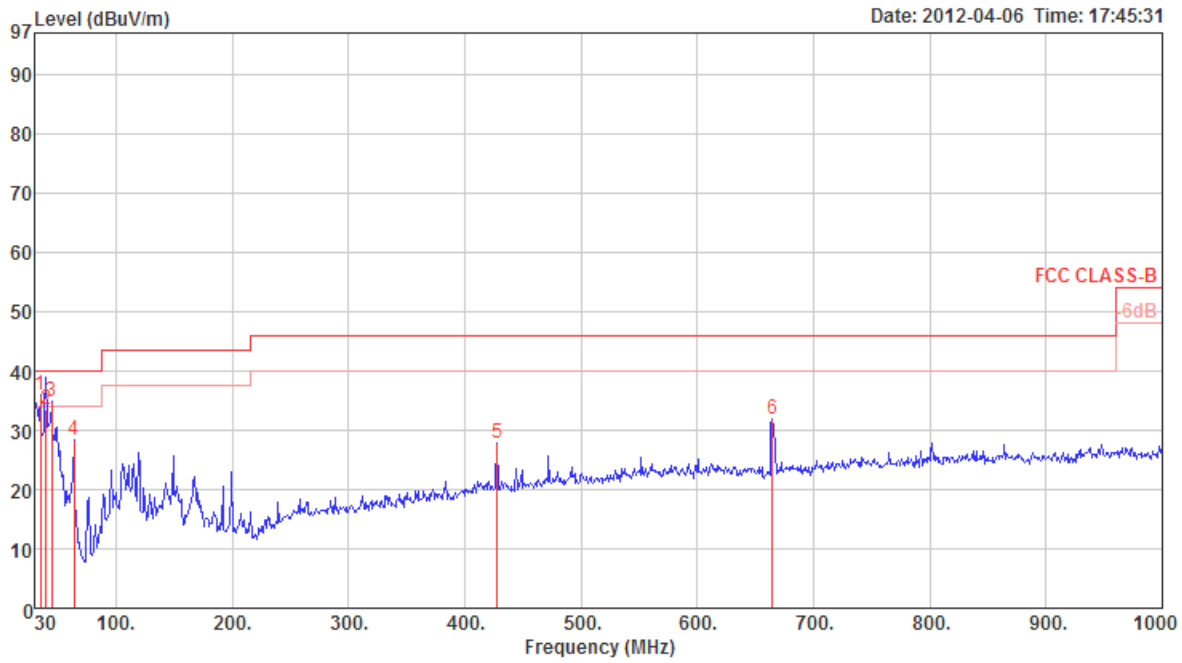
Temperature	23°C	Humidity	58%
Test Engineer	Wen Chao	Configurations	Normal Link

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Preamp Factor	Antenna Factor	T/Pos	A/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB/m	deg	cm		
1 p	34.85	33.51	40.00	-6.49	44.29	0.92	27.80	16.10	0	100	Peak	HORIZONTAL
2	199.75	34.69	43.50	-8.81	50.05	2.09	27.10	9.65	0	100	Peak	HORIZONTAL
3	239.52	33.37	46.00	-12.63	46.62	2.31	27.02	11.46	0	100	Peak	HORIZONTAL
4	577.08	34.84	46.00	-11.16	40.04	3.64	28.10	19.26	0	100	Peak	HORIZONTAL
5	612.00	37.26	46.00	-8.74	41.95	3.77	28.09	19.63	0	100	Peak	HORIZONTAL
6	1000.00	38.90	54.00	-15.10	40.18	4.84	27.00	20.88	0	100	Peak	HORIZONTAL

Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Preamp Factor	Antenna Factor	T/Pos	A/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB/m	deg	cm		
1 p	34.85	35.84	40.00	-4.16	46.62	0.92	27.80	16.10	0	100	Peak	VERTICAL
2 q	39.70	33.57	40.00	-6.43	47.80	0.99	27.80	12.58	192	100	QP	VERTICAL
3 !	44.55	34.77	40.00	-5.23	50.97	1.00	27.80	10.60	0	100	Peak	VERTICAL
4	63.95	28.26	40.00	-11.74	48.53	1.19	27.74	6.28	0	100	Peak	VERTICAL
5	427.70	27.96	46.00	-18.04	35.45	3.13	27.74	17.12	0	100	Peak	VERTICAL
6	664.38	31.84	46.00	-14.16	36.54	3.98	28.04	19.36	0	100	Peak	VERTICAL

Note:

The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.5.9. Results for Radiated Emissions (1GHz~10th Harmonic)

Temperature	23°C	Humidity	58%
Test Engineer	Wen Chao	Configurations	802.15.4 Zigbee CH 11
Test Date	Apr. 11, 2012		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4808.86	41.37	54.00	-12.63	40.10	3.29	33.02	35.04	Average	125	182	HORIZONTAL
2	4811.02	51.24	74.00	-22.76	49.97	3.29	33.02	35.04	Peak	125	182	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4808.87	46.89	54.00	-7.11	45.62	3.29	33.02	35.04	Average	100	216	VERTICAL
2	4811.04	56.41	74.00	-17.59	55.14	3.29	33.02	35.04	Peak	100	216	VERTICAL

Temperature	23℃	Humidity	58%
Test Engineer	Wen Chao	Configurations	802.15.4 Zigbee CH 18
Test Date	Apr. 11, 2012		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4880.84	41.97	54.00	-12.03	40.51	3.33	33.16	35.03	Average	154	182	HORIZONTAL
2	4880.84	52.08	74.00	-21.92	50.62	3.33	33.16	35.03	Peak	154	182	HORIZONTAL
3	7318.32	48.85	74.00	-25.15	44.23	4.06	35.96	35.40	Peak	100	177	HORIZONTAL
4	7321.16	37.90	54.00	-16.10	33.28	4.06	35.96	35.40	Average	100	177	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4878.85	56.70	74.00	-17.30	55.24	3.33	33.16	35.03	Peak	115	186	VERTICAL
2	4880.91	47.06	54.00	-6.94	45.60	3.33	33.16	35.03	Average	115	186	VERTICAL
3	7318.38	51.91	74.00	-22.09	47.29	4.06	35.96	35.40	Peak	100	271	VERTICAL
4	7318.58	41.50	54.00	-12.50	36.88	4.06	35.96	35.40	Average	100	271	VERTICAL

Temperature	23℃	Humidity	58%
Test Engineer	Wen Chao	Configurations	802.15.4 Zigbee CH 25
Test Date	Apr. 11, 2012		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4949.00	51.70	74.00	-22.30	50.04	3.37	33.30	35.01	Peak	130	331	HORIZONTAL
2	4950.85	41.80	54.00	-12.20	40.14	3.37	33.30	35.01	Average	130	331	HORIZONTAL
3	7423.40	50.37	74.00	-23.63	45.54	4.07	36.16	35.40	Peak	100	323	HORIZONTAL
4	7423.53	39.10	54.00	-14.90	34.27	4.07	36.16	35.40	Average	100	323	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4950.84	46.50	54.00	-7.50	44.84	3.37	33.30	35.01	Average	100	185	VERTICAL
2	4950.89	56.23	74.00	-17.77	54.57	3.37	33.30	35.01	Peak	100	185	VERTICAL
3	7423.56	51.66	74.00	-22.34	46.83	4.07	36.16	35.40	Peak	100	153	VERTICAL
4	7423.59	41.11	54.00	-12.89	36.28	4.07	36.16	35.40	Average	100	153	VERTICAL

Note:

The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.6. Band Edge Emissions Measurement

4.6.1. Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

4.6.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RB / VB (Emission in restricted band)	1MHz / 3 MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (Emission in non-restricted band)	100 KHz /100 KHz for Peak

4.6.3. Test Procedures

1. The test procedure is the same as section 4.5.3, only the frequency range investigated is limited to 100MHz around bandedges.
2. In case the emission is fail due to the used RB/VB is too wide, marker-delta method of FCC Public Notice DA00-705 will be followed.

4.6.4. Test Setup Layout

This test setup layout is the same as that shown in section 4.5.4.

4.6.5. Test Deviation

There is no deviation with the original standard.

4.6.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.6.7. Test Result of Band Edge and Fundamental Emissions

Temperature	23°C	Humidity	58%
Test Engineer	Wen Chao	Configurations	802.15.4 Zigbee CH 11, 18, 25
Test Date	Apr. 11, 2012		

Channel 11

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2372.60	60.67	74.00	-13.33	30.33	2.21	28.13	0.00	Peak	124	120	HORIZONTAL
2	2372.80	52.84	54.00	-1.16	22.50	2.21	28.13	0.00	Average	124	120	HORIZONTAL
3	2405.00	110.94				2.22	28.21	0.00	Average	124	120	HORIZONTAL
4	2405.60	116.00				2.22	28.21	0.00	Peak	124	120	HORIZONTAL

Item 3, 4 are the fundamental frequency at 2405 MHz.

Channel 18

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2344.00	46.68	54.00	-7.32	16.43	2.19	28.06	0.00	Average	122	117	HORIZONTAL
2	2344.40	56.52	74.00	-17.48	26.27	2.19	28.06	0.00	Peak	122	117	HORIZONTAL
3	2440.00	110.06				2.23	28.29	0.00	Average	122	117	HORIZONTAL
4	2440.40	114.05				2.23	28.29	0.00	Peak	122	117	HORIZONTAL
5	2492.70	54.49	74.00	-19.51	23.80	2.27	28.42	0.00	Peak	122	117	HORIZONTAL
6	2535.90	43.23	54.00	-10.77	12.43	2.29	28.51	0.00	Average	122	117	HORIZONTAL

Item 3, 4 are the fundamental frequency at 2440 MHz.

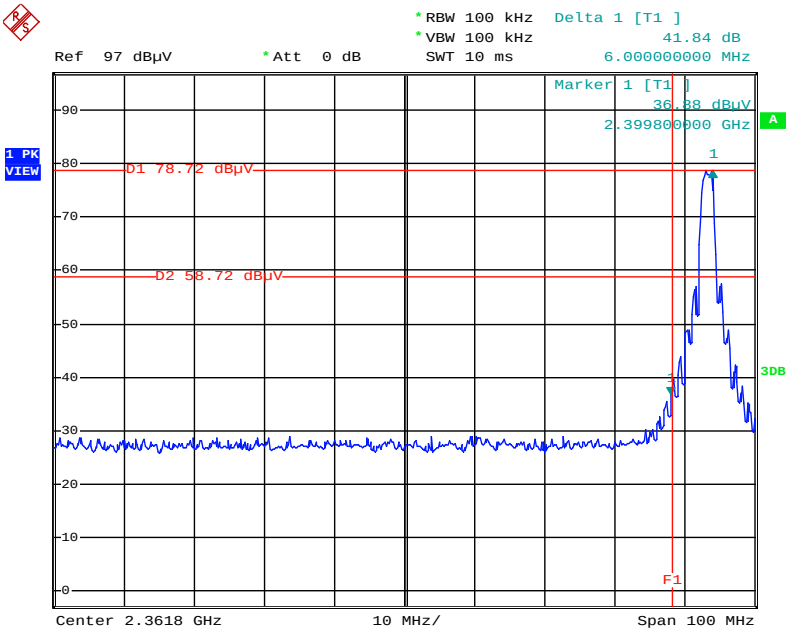
Channel 25

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2474.60	113.94				2.26	28.38	0.00	Peak	123	92	HORIZONTAL
2	2475.00	110.01				2.26	28.38	0.00	Average	123	92	HORIZONTAL
3	2483.50	60.28	74.00	-13.72	29.64	2.26	28.38	0.00	Peak	123	92	HORIZONTAL
4	2506.90	49.65	54.00	-4.35	18.91	2.27	28.47	0.00	Average	123	92	HORIZONTAL

Item 1, 2 are the fundamental frequency at 2475 MHz.

For Emission not in Restricted Band

Low Band Edge Plot on Configuration 802.15.4 Zigbee / 2405 MHz



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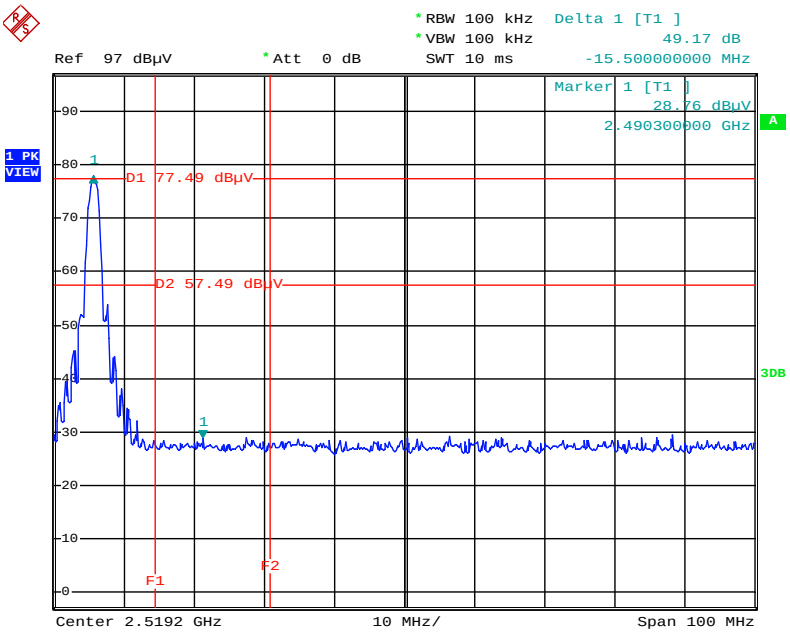
High Band Edge Plot on Configuration 802.15.4 Zigbee / 2475 MHz



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4.7. Antenna Requirements

4.7.1. Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. 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 the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

4.7.2. Antenna Connector Construction

Please refer to section 3.3 in this test report; antenna connector complied with the requirements.

5. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMI Test Receiver	R&S	ESCS 30	100377	9kHz ~ 2.75GHz	Sep. 01, 2011	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Oct. 28, 2011	Conduction (CO01-CB)
V- LISN	Schwarzbeck	NSLK 8127	8127-478	9K ~ 30MHz	Nov. 16, 2011	Conduction (CO01-CB)
PULSE LIMITER	R&S	ESH3-Z2	100430	9K~30MHz	Jan. 04, 2012	Conduction (CO01-CB)
COND Cable	-	Cable	-	0.15MHz~30MHz	Dec. 04, 2011	Conduction (CO01-CB)
BILOG ANTENNA	Schaffner	CBL6112D	22021	20MHz ~ 2GHz	Oct. 17, 2011	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz~18GHz	Nov. 22, 2011	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10991	0.1MHz ~ 1.3GHz	Nov. 17, 2011	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Nov. 23, 2011	Radiation (03CH01-CB)
Spectrum analyzer	R&S	FSP	100304	9kHz ~ 40GHz	Nov. 22, 2011	Radiation (03CH01-CB)
EMI Test Receiver	R&S	ESCS 30	100355	9KHz ~ 2.75GHz	Mar. 22, 2012	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9 kHz - 30 MHz	Sep. 09, 2011	Radiation (03CH01-CB)
Turn Table	INN CO	CO 2000	N/A	0 ~ 360 degree	N/A	Radiation (03CH01-CB)
Antenna Mast	INN CO	CO2000	N/A	1 m - 4 m	N/A	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-1	N/A	30 MHz - 1 GHz	Nov. 17, 2011	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-1	N/A	1 GHz – 26.5 GHz	Nov. 17, 2011	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-2	N/A	1 GHz – 26.5 GHz	Nov. 17, 2011	Radiation (03CH01-CB)
Spectrum analyzer	R&S	FSP30	100023	9KHz~30GHz	Mar. 15, 2012	Conducted (TH01-CB)
Spectrum analyzer	R&S	FSV30	101026	9KHz~30GHz	Jul. 23, 2011	Conducted (TH01-CB)
Thermo-Hygro Meter	N/A	HC 520	#1	15~70 degree	Nov. 02, 2011	Conducted (TH01-CB)
Horn Antenna	COM-POWER	AH-118	071187	1GHz – 18GHz	Mar. 18, 2012	Conducted (TH01-CB)
Horn Antenna	COM-POWER	AH-118	071042	1GHz – 18GHz	Oct. 14, 2011	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-7	-	1 GHz – 26.5 GHz	Nov. 17, 2011	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-8	-	1 GHz – 26.5 GHz	Nov. 17, 2011	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-9	-	1 GHz – 26.5 GHz	Nov. 17, 2011	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-10	-	1 GHz – 26.5 GHz	Nov. 17, 2011	Conducted (TH01-CB)

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
RF Cable-high	Woken	High Cable-11	-	1 GHz – 26.5 GHz	Nov. 17, 2011	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-12	-	1 GHz – 26.5 GHz	Nov. 17, 2011	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-13	-	1 GHz – 26.5 GHz	Nov. 17, 2011	Conducted (TH01-CB)
Power Sensor	Anritsu	MA2411B	0917223	300MHz~40GHz	Sep. 13, 2011	Conducted (TH01-CB)
Power Meter	Anritsu	ML2495A	1035008	300MHz~40GHz	Sep. 08, 2011	Conducted (TH01-CB)

Note: Calibration Interval of instruments listed above is one year.

Note: *Calibration Interval of instruments listed above is two years.

6. TEST LOCATION

SHIJR	ADD	:	6Fl., No. 106, Sec. 1, Shintai 5th Rd., Shijr City, Taipei, Taiwan 221, R.O.C.
	TEL	:	886-2-2696-2468
	FAX	:	886-2-2696-2255
HWA YA	ADD	:	No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.
	TEL	:	886-3-327-3456
	FAX	:	886-3-318-0055
LINKOU	ADD	:	No. 30-2, Dingfu Tsuen, Linkou Shiang, Taipei, Taiwan 244, R.O.C
	TEL	:	886-2-2601-1640
	FAX	:	886-2-2601-1695
DUNGHU	ADD	:	No. 3, Lane 238, Kangle St., Neihu Chiu, Taipei, Taiwan 114, R.O.C.
	TEL	:	886-2-2631-4739
	FAX	:	886-2-2631-9740
JUNGHE	ADD	:	7Fl., No. 758, Jungjeng Rd., Junghe City, Taipei, Taiwan 235, R.O.C.
	TEL	:	886-2-8227-2020
	FAX	:	886-2-8227-2626
NEIHU	ADD	:	4Fl., No. 339, Hsin Hu 2nd Rd., Taipei 114, Taiwan, R.O.C.
	TEL	:	886-2-2794-8886
	FAX	:	886-2-2794-9777
JHUBEI	ADD	:	No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C.
	TEL	:	886-3-656-9065
	FAX	:	886-3-656-9085

7. TAF CERTIFICATE OF ACCREDITATION

Certificate No. : L1190-091230

財團法人全國認證基金會
Taiwan Accreditation Foundation

Certificate of Accreditation

This is to certify that

Sporton International Inc.
EMC & Wireless Communications Laboratory
No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

is accredited in respect of laboratory

Accreditation Criteria	:	ISO/IEC 17025:2005
Accreditation Number	:	1190
Originally Accredited	:	December 15, 2003
Effective Period	:	January 10, 2010 to January 09, 2013
Accredited Scope	:	Testing Field, see described in the Appendix
Specific Accreditation Program	:	Accreditation Program for Designated Testing Laboratory for Commodities Inspection Accreditation Program for Telecommunication Equipment Testing Laboratory Accreditation Program for BSMI Mutual Recognition Arrangment with Foreign Authorities

Jay-San Chen
President, Taiwan Accreditation Foundation
Date : December 30, 2009

P1, total 22 pages

The Appendix forms an integral part of this Certificate, which shall be invalid when use without the Appendix