

HCT CO., LTD.

CERTIFICATE OF COMPLIANCE FCC Certification

Applicant Name:
MAXFOR Technology Inc

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Date of Issue:

September 13, 2013

Test Site/Location:

HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-
myeon, Icheon-si, Gyeonggi-do, Korea

Report No.: HCTR1309FR01-2

HCT FRN: 0005866421

FCC ID : X6VMFA-200

APPLICANT : MAXFOR Technology Inc

FCC Model(s): MFA-200

EUT Type: INDOOR AIR QUALITY MONITOR

Max. RF Output Power: 4.924 dBm (3.107 mW)

Frequency Range: 2405 MHz -2470 MHz(Zigbee Mode)

Modulation type : GFSK

FCC Classification: Digital Transmission System(DTS)

FCC Rule Part(s): Part 15.247

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998, 21 U.S.C. 853(a)



Report prepared by
: Jong Seok Lee
Test engineer of RF Team



Approved by
: Chang Seok Choi
Manager of RF Team

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FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		www.hct.co.kr
Test Report No. HCTR1309FR01-2	Date of Issue: September 13, 2013	EUT Type: INDOOR AIRQUALITY MONITOR	FCC ID: X6VMFA-200

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCTR1309FR01	September 09, 2013	- First Approval Report
HCTR1309FR01-1	September 12, 2013	- Add the Duty Cycle in Section 7 - Revised the Cable Loss Information on Page 13,20 and 24 - Revised the Mode to Zigbee from LE on Page 14
HCTR1309FR01-2	September 13, 2013	- Add the Adapter Information on Page 4

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1. GENERAL INFORMATION

Applicant: MAXFOR Technology Inc

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Gyeonggi-Do 446-908 South Korea

FCC ID: X6VMFA-200

EUT Type: INDOOR AIRQUALITY MONITOR

Model name(s): MFA-200

Date(s) of Tests: August 12, 2013 ~ September 06, 2013

Place of Tests: HCT Co., Ltd.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea
(IC Recognition No. : 5944A-3)

2. EUT DESCRIPTION

EUT Type	INDOOR AIR QUALITY MONITOR	
FCC Model Name	MFA-200	
Power Supply	DC 9.0 V	
Adapter Information	Manufacturer: Channel Well Technology Model Name : GC99D036009 Input : 100 V ~ 240 V, 50/60 Hz, 1200 mA Output : 9.0 V, 4 A	
Frequency Range	TX: 2405 MHz ~ 2470 MHz RX: 2405 MHz ~ 2470 MHz	
Max. RF Output Power	Peak	4.924 dBm (3.107 mW)
	Average	4.760 dBm (2.992 mW)
Operating Mode	Zigbee Mode	
Modulation Type	GFSK	
Antenna Specification	Manufacturer: Advanced Ceramic X(Internal), WINIZEN(External) Antenna type: Chip Antenna(Internal), Dipole Antenna(External) Peak Gain : 3.0 dBi(Internal), 3.377 dBi(External)	

3. TEST METHODOLOGY

FCC KDB 558074 D01 DTS Meas Guidance v03r01 dated April 09, 2013 entitled "Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) and the measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices(ANSI C63.4-2003) Operating Under §15.247" were used in the measurement.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4. (Version :2003) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4. (Version: 2003)

Conducted Antenna Terminal

See Section from 9.1 to 9.2.(KDB 558074)

3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

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4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 105-1, Jangam-ri, Majang-Myeon, Icheon-si, Kyunggi-Do, 467-811, Korea. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2003) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated June 21, 2011 (Registration Number: 90661)

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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."

* In case of internal antenna, the antenna is permanently attached. And in case of external antenna is used a unique connector type(Reversed sma-type).

*The E.U.T Complies with the requirement of §15.203

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7. SUMMARY TEST OF RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
Duty Cycle	N/A	N/A	CONDUCTED	N/A
6 dB Bandwidth	§15.247(a)(2)	> 500 kHz		PASS
Conducted Maximum Peak Output Power	§15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge(Out of Band Emissions)	§15.247(d)	Conducted < 20 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 8.6		PASS
Radiated Spurious Emissions	§15.205, 15.209	cf. Section 8.5.1	RADIATED	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 8.5.2		PASS

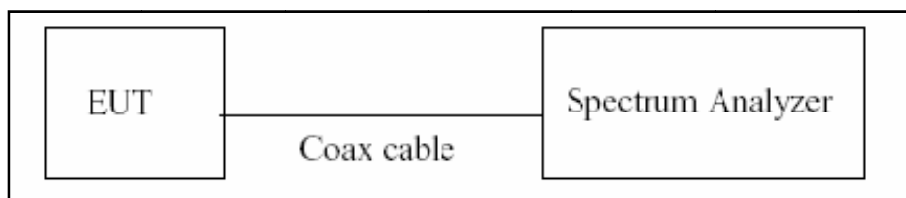
8. TEST RESULT

8.1 DUTY CYCLE

TEST PROCEDURE

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set $RBW \geq OBW$ if possible; otherwise, set RBW to the largest available value. Set $VBW \geq RBW$. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$ and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if $T \leq 16.7$ microseconds.)

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We tested according to the zero-span measurement method, 6.0)b) in KDB 558074(issued 04/09/2013)

The largest available value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if $T \leq 6.25$ microseconds. ($50/6.25 = 8$)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are $> 50/T$.

1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (\geq RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on} / T_{total} and Duty Cycle Factor = $10 \cdot \log(1/\text{Duty Cycle})$

Zigbee Mode	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor(dB)
	-	-	1	0

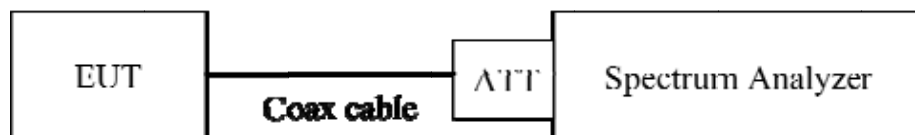
8.2 6dB BANDWIDTH MEASUREMENT

Test Requirements and limit, §15.247(a)(2)

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6dB bandwidth is 500 kHz.

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Page 5 in KDB 558074, issued 04/09/2013)

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

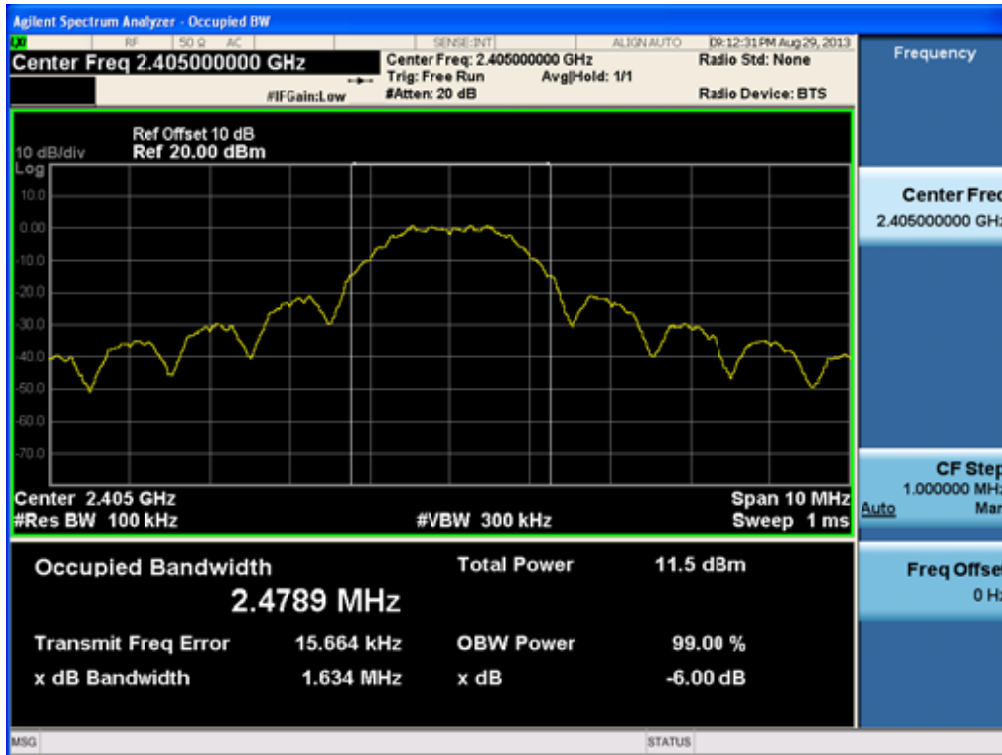
Allow the trace to stabilize

Note : We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

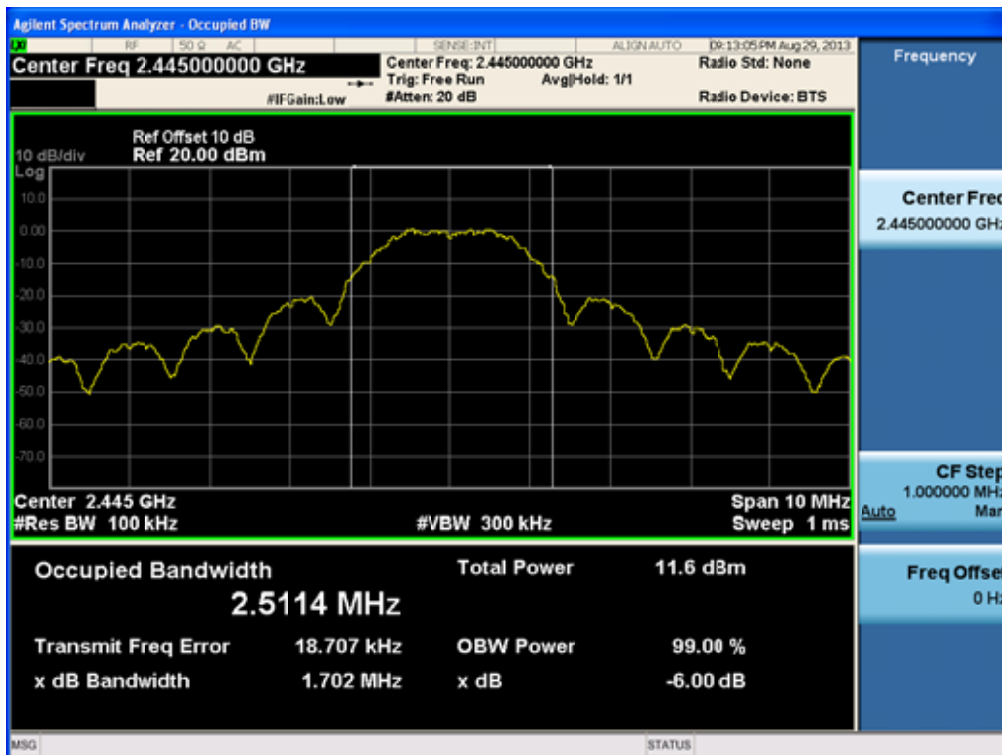
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RESULT PLOTS

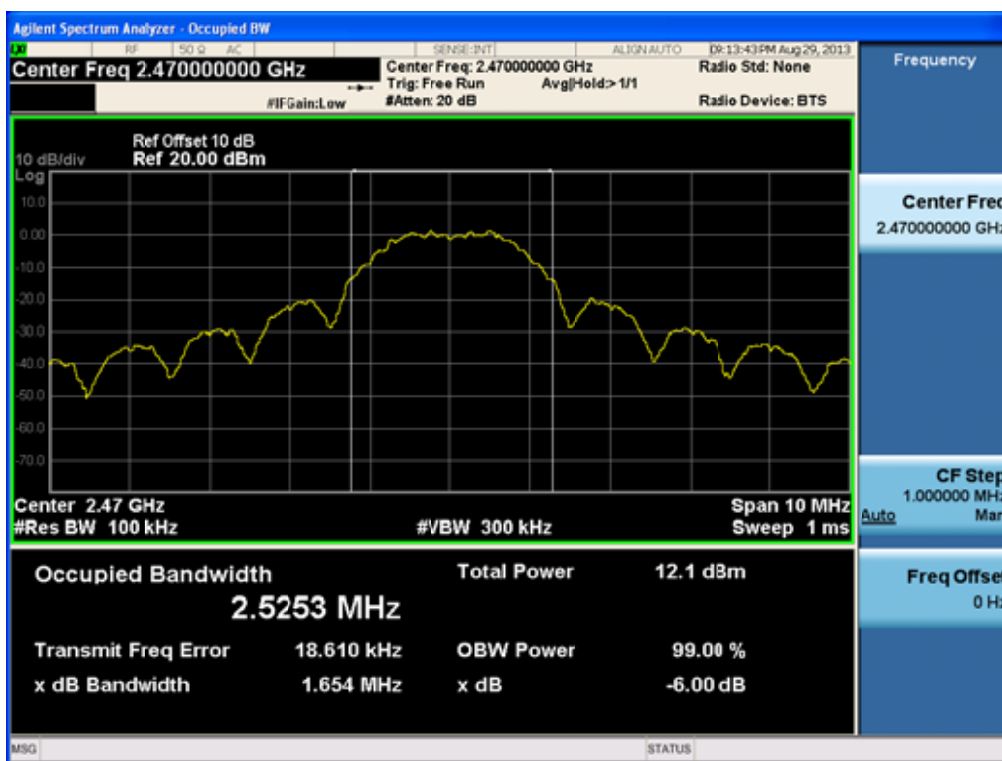
6dB Bandwidth plot (Low-CH)



6dB Bandwidth plot (Mid-CH)



6dB Bandwidth plot (High-CH)



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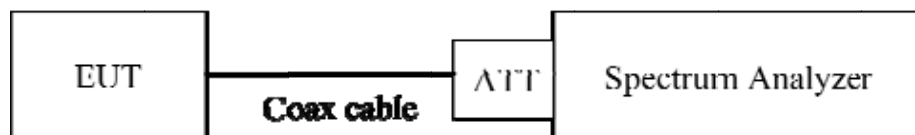
8.3 OUTPUT POWER MEASUREMENT

Test Requirements and limit, §15.247(b)(3)

A transmitter antenna terminal of EUT is connected to the input of a Spectrum Analyzer. Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We use the spectrum analyzer's integrated band power measurement function.

This EUT TX condition is 100 % duty cycle operating mode by Zigbee mode test program.

The Spectrum Analyzer is set to

- Peak Power (Procedure 9.1.1 in KDB 558074, issued 04/09/2013)

RBW \geq DTS Bandwidth

VBW $\geq 3 \times$ RBW

SPAN $\geq 3 \times$ RBW

Detector Mode = Peak

Sweep = auto couple

Trace Mode = max hold

Allow trace to fully stabilize.

Use peak marker function to determine the peak amplitude level

- Average Power (Procedure 9.2.2.2 in KDB 558074, issued 04/09/2013)

Measure the duty cycle

Set span to at least 1.5 times the OBW

RBW = 1-5 % of the OBW, not to exceed 1 MHz.

VBW $\geq 3 \times$ RBW.

Number of points in sweep $\geq 2 \times$ span / RBW. (This gives bin-to-bin spacing \leq RBW/2, so that narrowband signals are not lost between frequency bins.)

Sweep time = auto.

Detector = RMS(i.e., power averaging)

Do not use sweep triggering. Allow the sweep to "free run".

Trace average at least 100 traces in power averaging(RMS) mode.

Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.

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Sample Calculation

Output Power = Reading Value + ATT loss + Cable loss(1 ea)

Output Power = 10 dBm + 10 dB + 0.8 dB = 21.0 dBm

Note :

1. Spectrum reading values are not plot data. The power results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 10.0 dB is offset for 2.4 GHz Band.

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TEST RESULTS-Peak

Conducted Output Power Measurements

Zigbee Mode		Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.		
2405	11	4.257	30
2445	19	4.608	30
2470	24	4.924	30

TEST RESULTS-Average

Conducted Output Power Measurements

Zigbee Mode		Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.		
2405	11	4.13	30
2445	19	4.45	30
2470	24	4.76	30

RESULT PLOTS-Peak

Conducted Output Power (Low-CH)

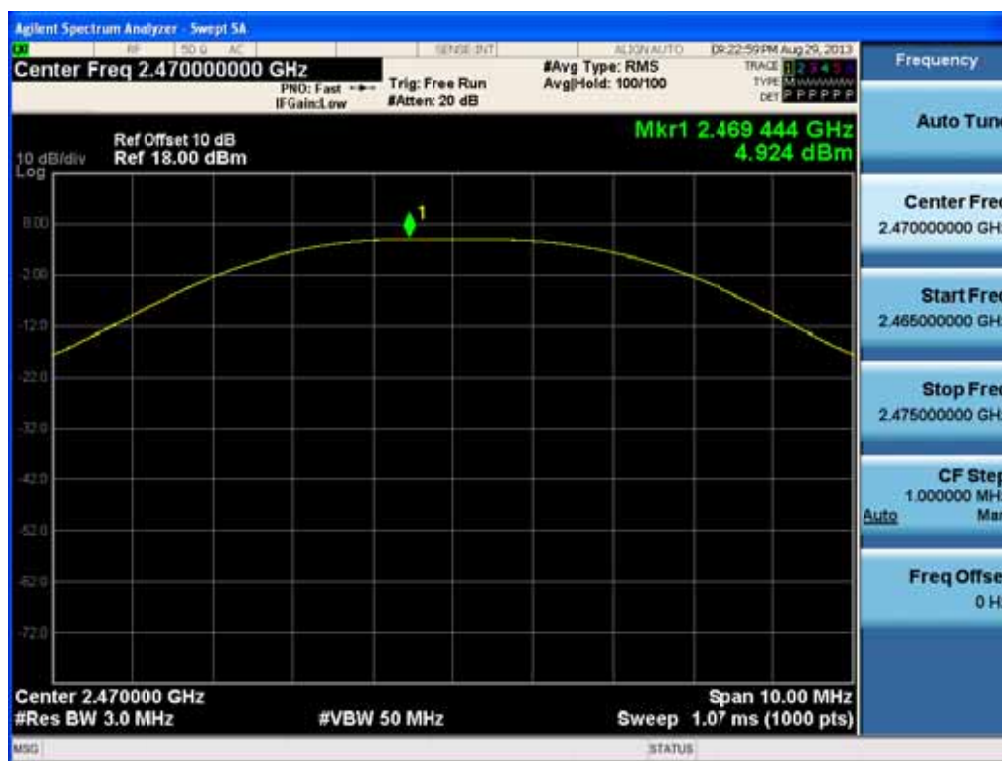


Conducted Output Power (Mid-CH)



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Conducted Output Power (High-CH)



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RESULT PLOTS-Average

Conducted Output Power (Low-CH)



Conducted Output Power (Mid-CH)



Conducted Output Power (High-CH)



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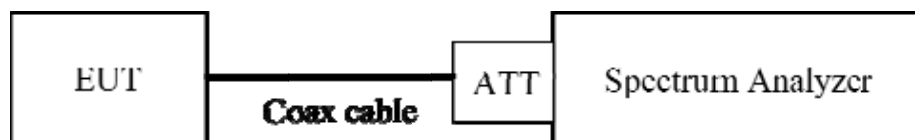
8.4 POWER SPECTRAL DENSITY

Test Requirements and limit, §15.247(e)

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard – The transmitter power density average over 1-second interval shall not be greater than 8dBm in any 3kHz BW.

TEST CONFIGURATION



TEST PROCEDURE

We tested according to Procedure 10.2 in KDB 558074, issued 04/09/2013

The spectrum analyzer is set to :

Set analyzer center frequency to DTS channel center frequency.

Span = 1.5 times the DTS channel bandwidth.

RBW = 3 kHz ≤ RBW ≤ 100 kHz.

VBW ≥ 3 x RBW.

Sweep = auto couple

Detector = peak

Trace Mode = max hold

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Sample Calculation

$$\begin{aligned} \text{PSD} &= \text{Reading Value} + \text{ATT loss} + \text{Cable loss}(1 \text{ ea}) \\ &= -5 \text{ dBm} + 10 \text{ dB} + 0.8 \text{ dB} = 5.8 \text{ dBm} \end{aligned}$$

Note :

1. Spectrum reading values are not plot data. The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 10.0 dB is offset for 2.4 GHz Band.

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TEST RESULTS

Conducted Power Density Measurements

Frequency (MHz)	Channel No.	Mode	Test Result		
			PSD (dBm)	Limit (dBm)	Pass/ Fail
2405	11	Zigbee	-10.996	8	Pass
2445	19		-10.133	8	Pass
2470	24		-10.024	8	Pass

RESULT PLOTS

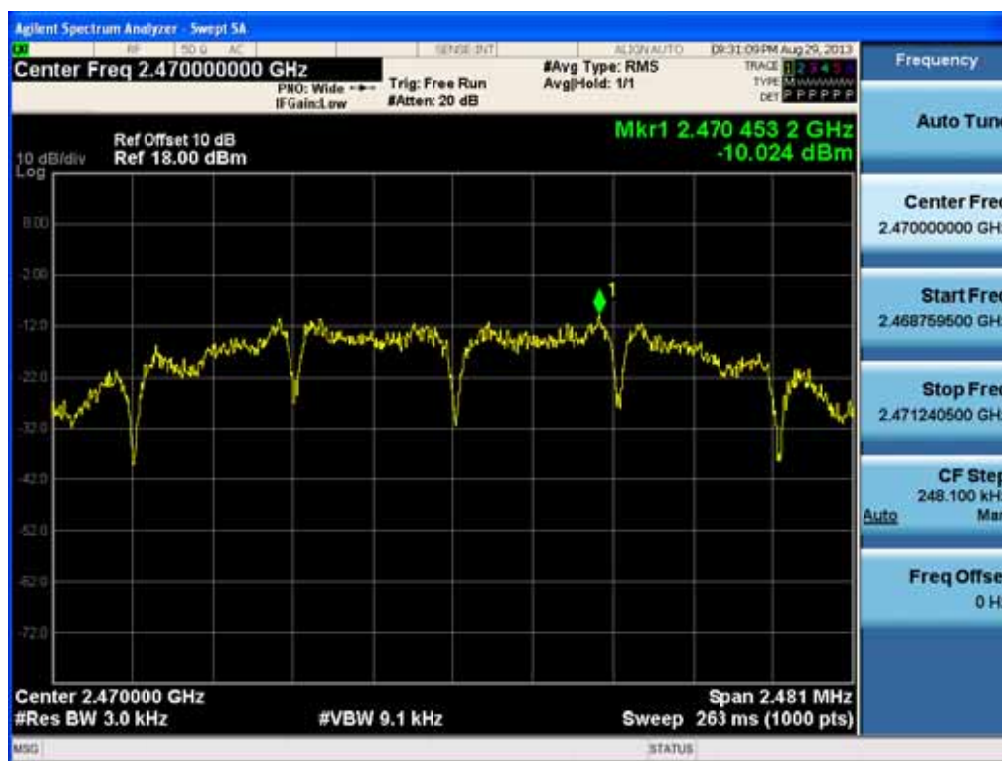
Power Spectral Density (Low-CH)



Power Spectral Density (Mid-CH)



Power Spectral Density (High-CH)



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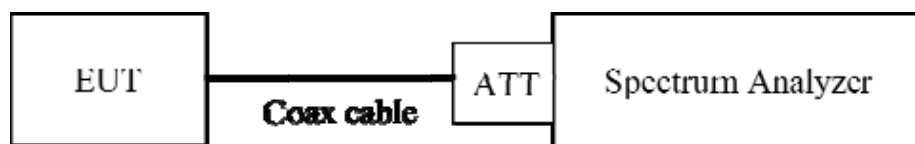
8.5 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

Test Requirements and limit, §15.247(d)

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Limit : 20 dBc

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. (Procedure 11.0 in KDB 558074, issued 04/09/2013)

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Set span to encompass the spectrum to be examined

Detector = Peak

Trace Mode = max hold

Sweep time = auto couple

Ensure that the number of measurement points \geq Span/RBW

Allow trace to fully stabilize.

Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 10th harmonic range with the transmitter set to the lowest, middle, and highest channels.

Note :

1. The band edge results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 10.0 dB is

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offset for 2.4 GHz Band.

4. In case of conducted spurious emissions test, please check factors blow table.
5. In order to simplify the report, attached plots were only the worst case channel and data rate.

FACTORS FOR FREQUENCY

Freq(MHz)	Factor(dB)
30	9.95
100	10.01
200	10.03
300	10.04
400	10.05
500	10.04
600	10.03
700	10.09
800	10.10
900	10.08
1000	10.11
2000	10.25
2400*	10.19
2500*	10.26
3000	10.27
4000	10.22
5000	10.48
5700*	10.42
5800*	10.48
6000	10.48
7000	10.57
8000	10.45
9000	10.50
10000	10.64
11000	10.69
12000	10.75
13000	10.92
14000	11.90
15000	11.00
16000	11.03
17000	10.93
18000	10.96

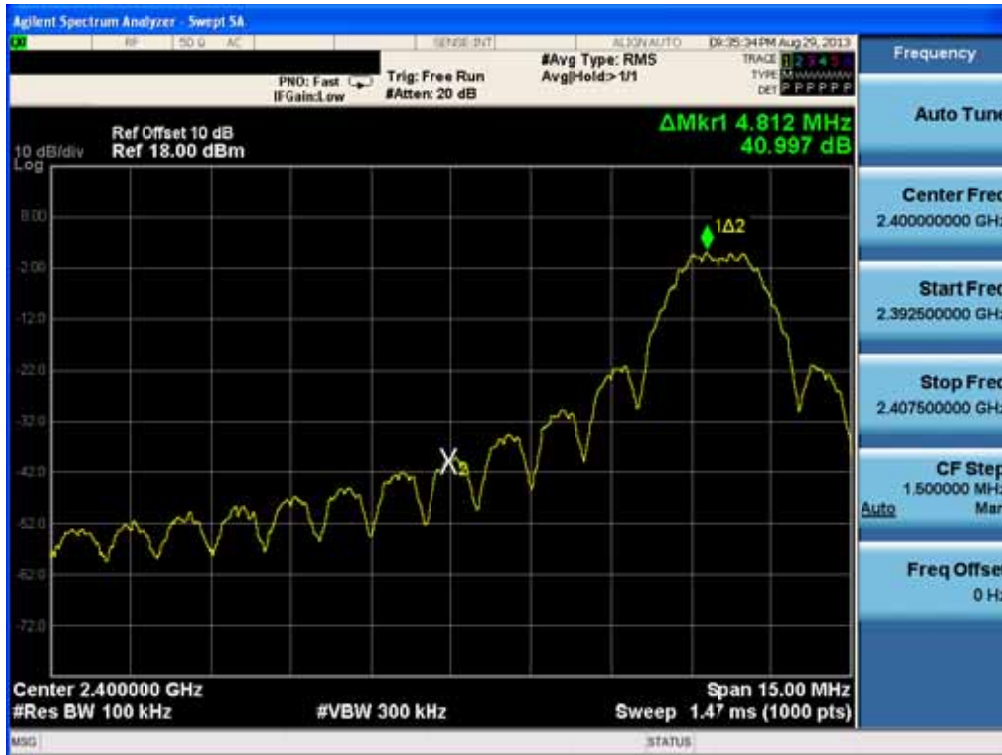
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19000	10.85
20000	12.11
21000	11.17
22000	10.99
23000	11.12
24000	11.10
25000	11.42

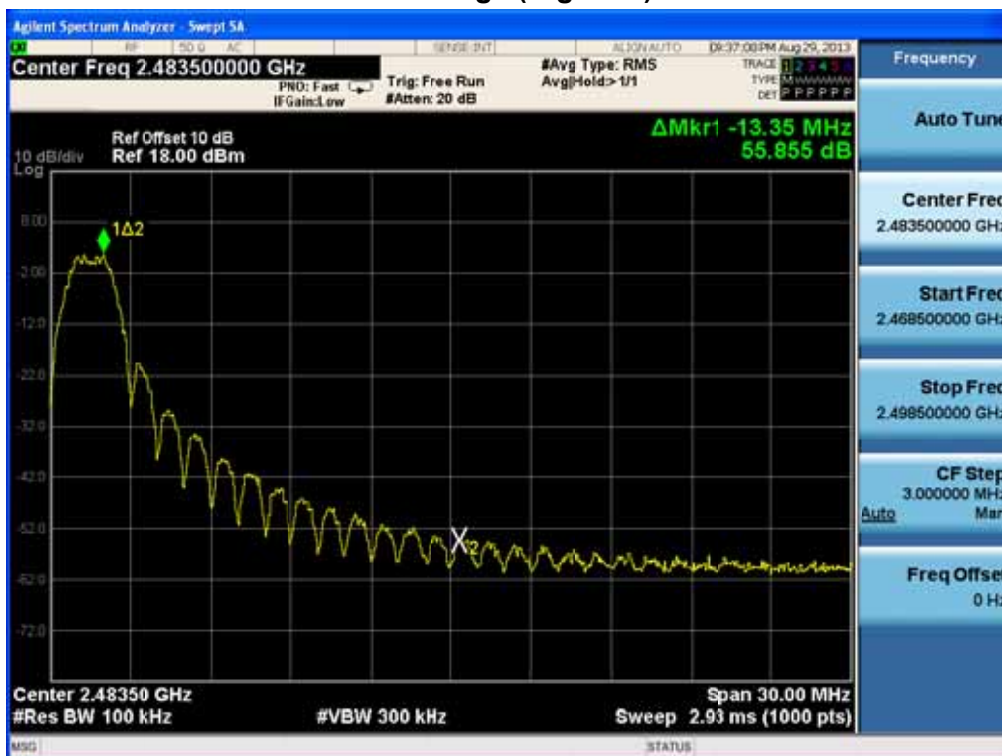
Note : 1. '*' is fundamental frequency range.
2. Factor = Cable loss + Attenuator loss

RESULT PLOTS

BandEdge (Low-CH)



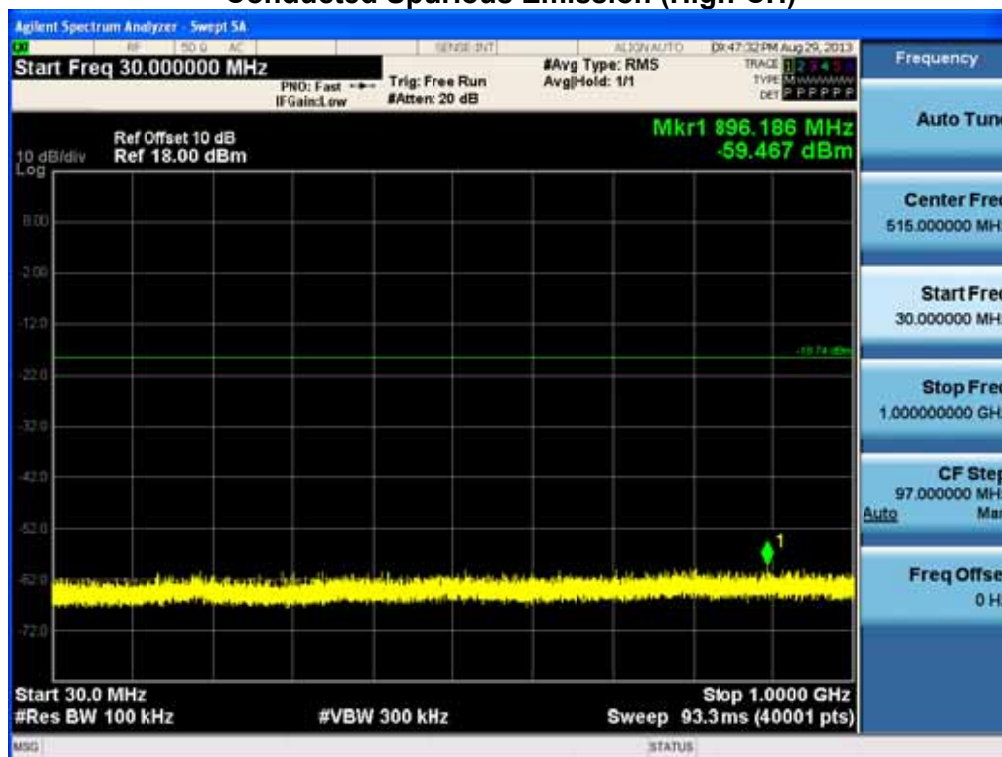
BandEdge (High-CH)



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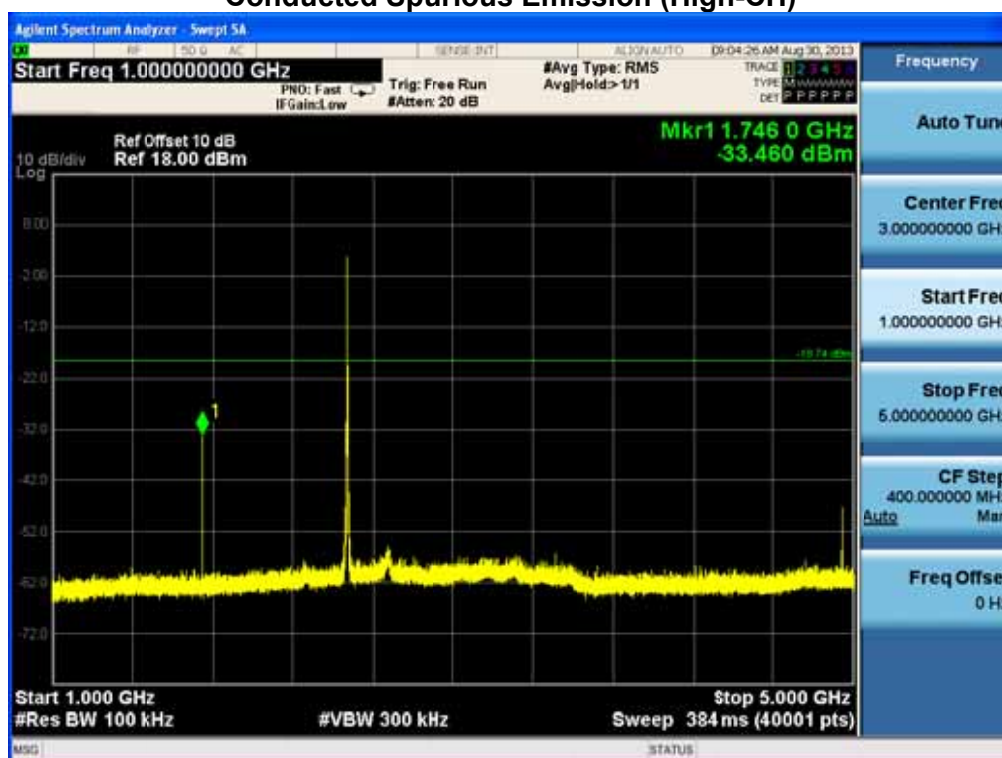
30 MHz ~ 1 GHz

Conducted Spurious Emission (High-CH)



1 GHz ~ 5 GHz

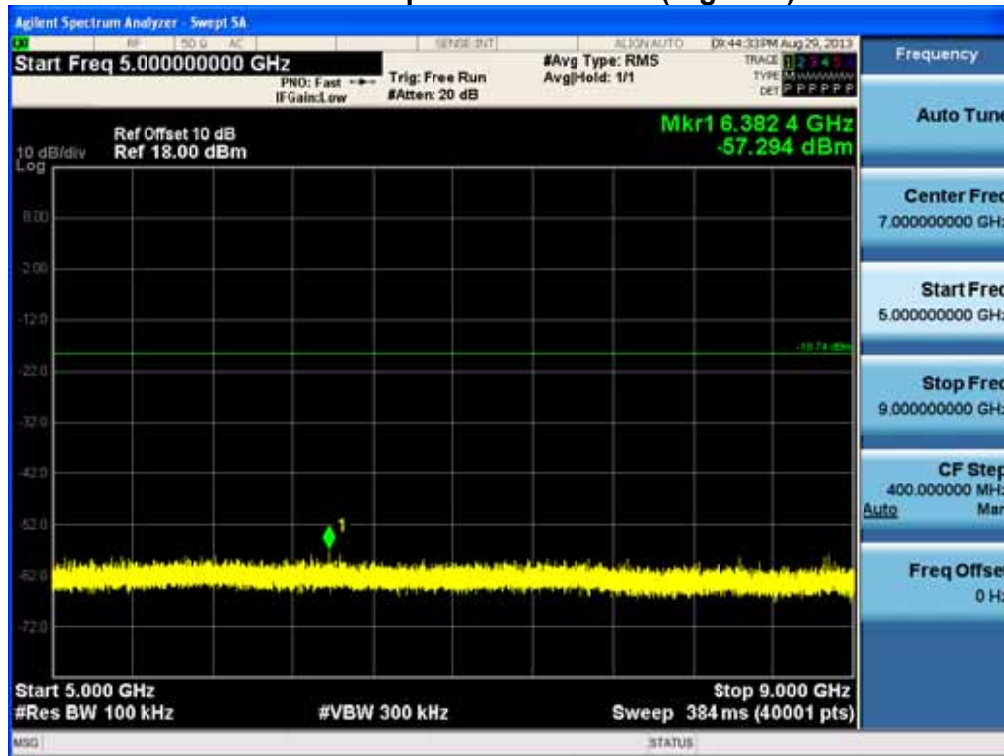
Conducted Spurious Emission (High-CH)



FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		www.hct.co.kr
Test Report No. HCTR1309FR01-2	Date of Issue: September 13, 2013	EUT Type: INDOOR AIRQUALITY MONITOR	FCC ID: X6VMFA-200

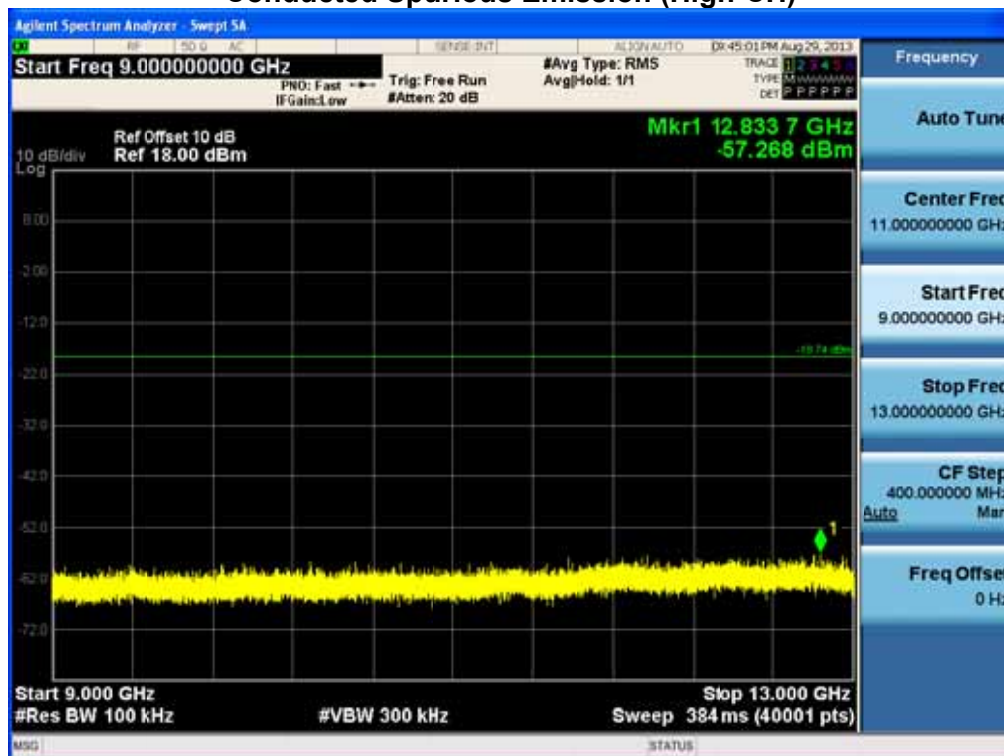
5 GHz ~ 9 GHz

Conducted Spurious Emission (High-CH)



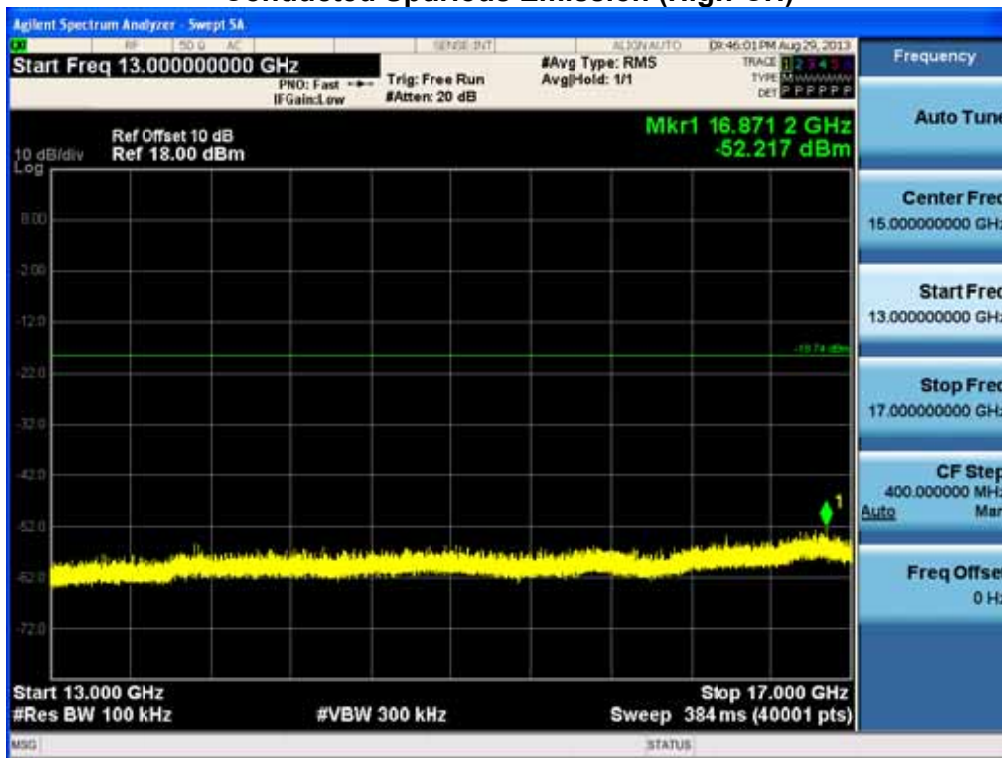
9 GHz ~ 13 GHz

Conducted Spurious Emission (High-CH)



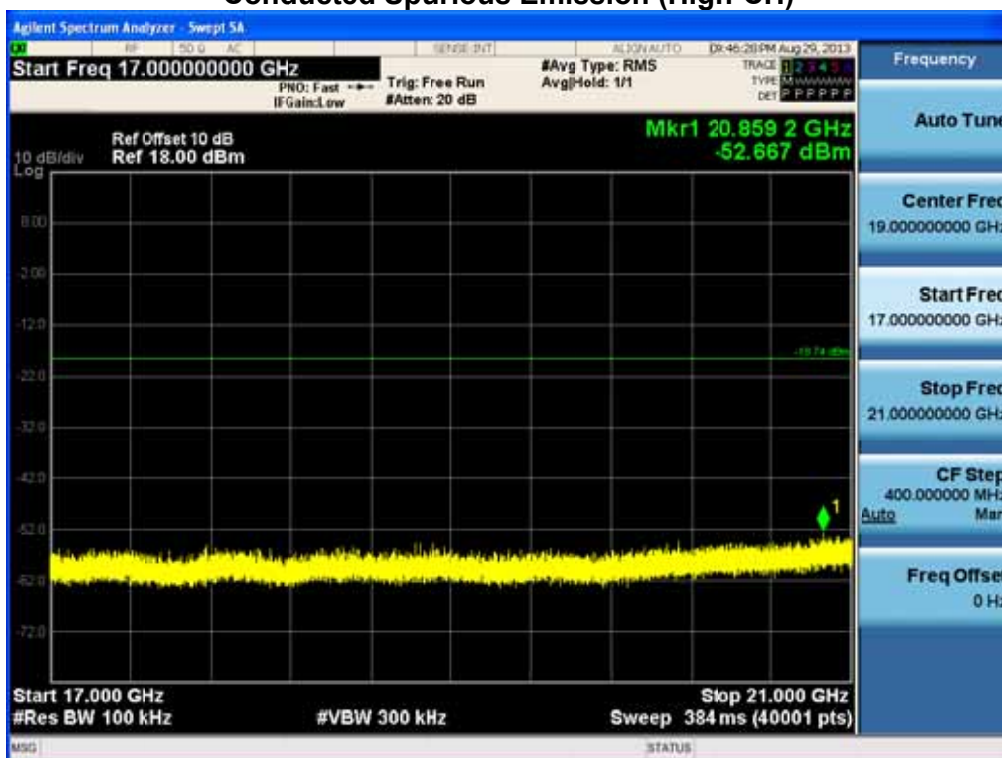
13 GHz ~ 17 GHz

Conducted Spurious Emission (High-CH)



17 GHz ~ 21 GHz

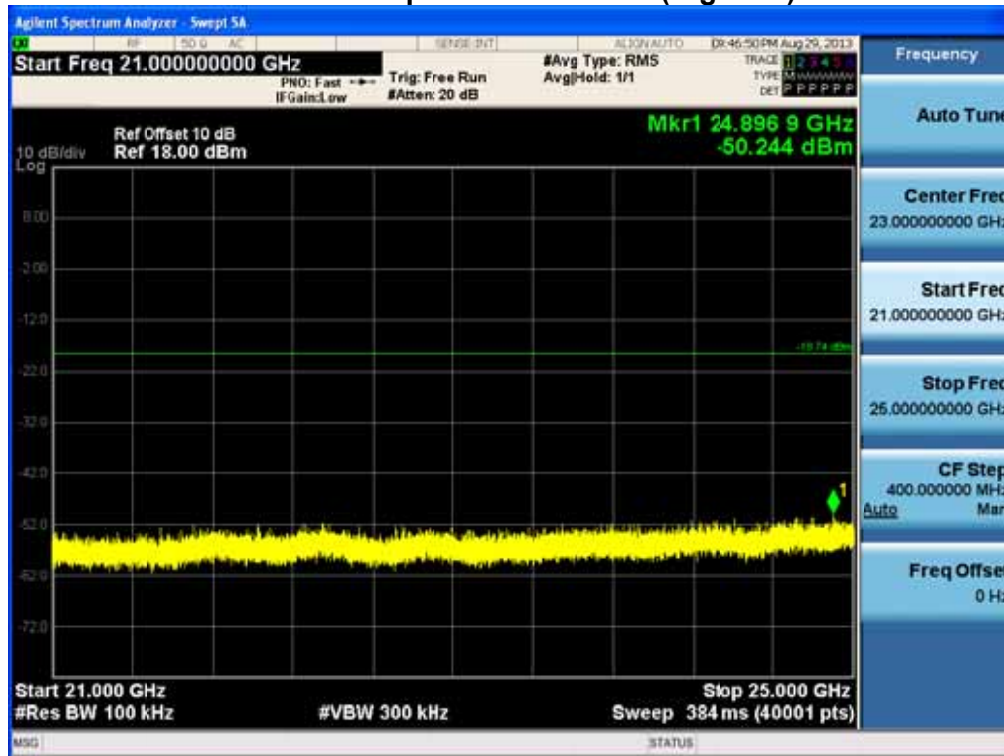
Conducted Spurious Emission (High-CH)



FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT			www.hct.co.kr
Test Report No. HCTR1309FR01-2	Date of Issue: September 13, 2013	EUT Type: INDOOR AIRQUALITY MONITOR		FCC ID: X6VMFA-200

21 GHz ~ 25 GHz

Conducted Spurious Emission (High-CH)



FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		www.hct.co.kr
Test Report No. HCTR1309FR01-2	Date of Issue: September 13, 2013	EUT Type: INDOOR AIRQUALITY MONITOR	FCC ID: X6VMFA-200

8.6 RADIATED MEASUREMENT.

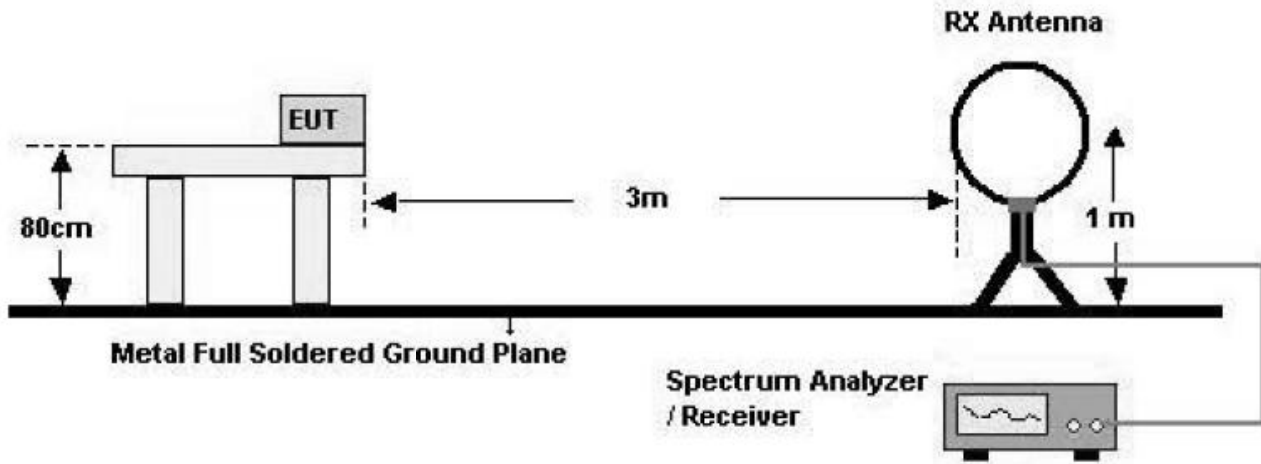
8.6.1 RADIATED SPURIOUS EMISSIONS.

Test Requirements and limit, §15.205, §15.209

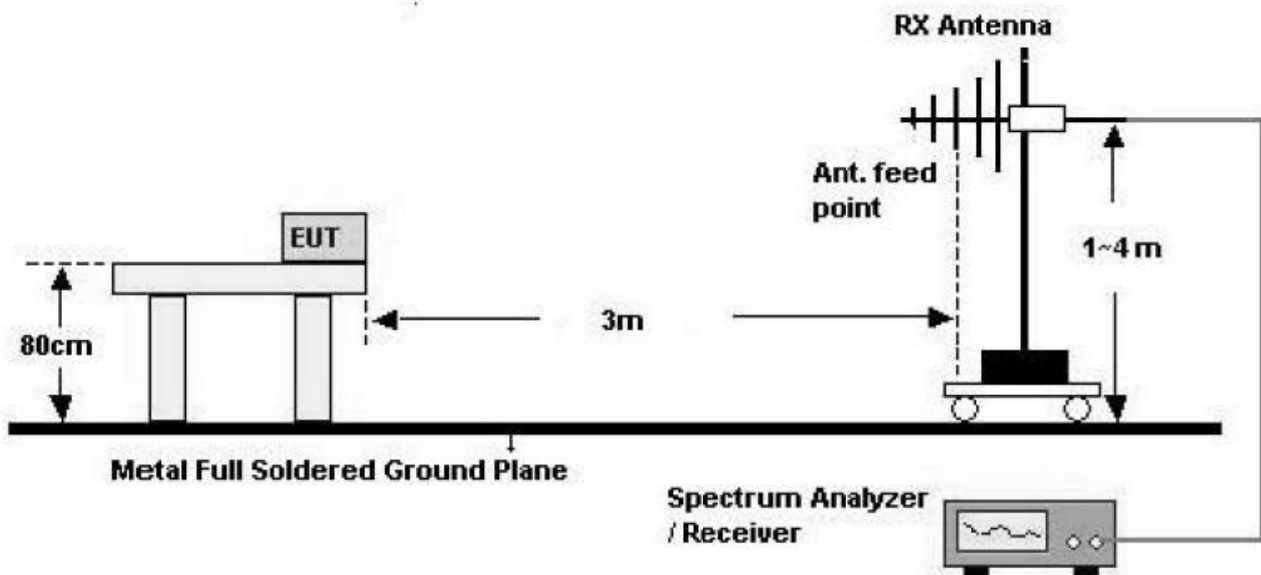
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

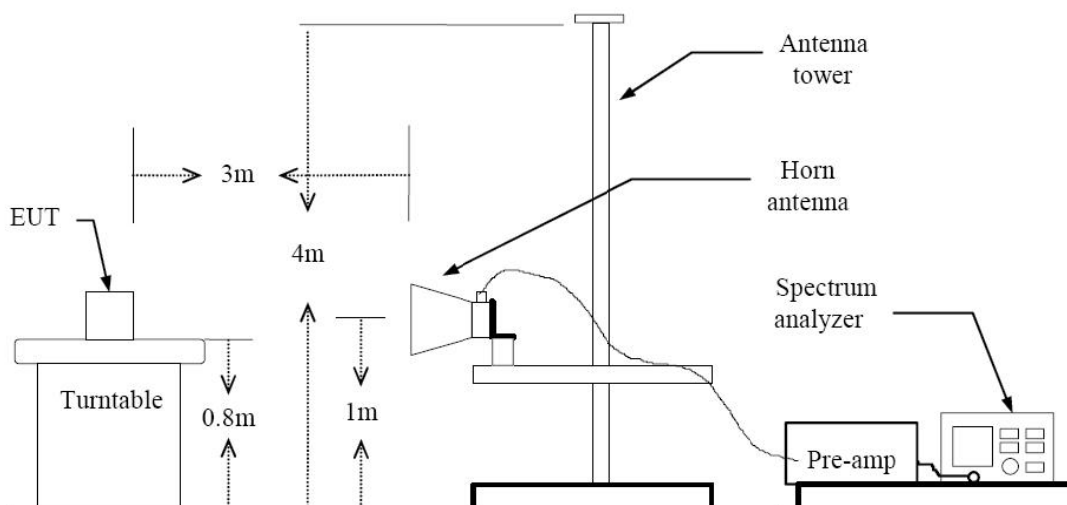
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



TEST PROCEDURE USED

ANSI C63.4(2003)

Method 12.2.4 in KDB 558074, issued 04/09/2013 (Peak)

Method 12.2.5.1 in KDB 558074, issued 04/09/2013(Average Case 1)

Method 12.2.5.3 in KDB 558074, issued 04/09/2013(Average Case 2)

Spectrum Setting

- Peak

Peak emission levels are measured by setting the instrument as follows:

RBW = cf. Table 1.

VBW $\geq 3 \times$ RBW.

Detector = Peak.

Sweep time = auto.

Trace mode = max hold.

Allow sweeps to continue until the trace stabilizes.

(Note that the required measurement time may be longer for low duty cycle applications).

Table 1 —RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

- Average

Case 1

If the EUT can be configured or modified to transmit continuously (duty cycle ≥ 98 percent) then the average emission levels shall be measured using the following method (with EUT transmitting continuously).

RBW = 1 MHz (unless otherwise specified).

VBW $\geq 3 \times$ RBW.

Detector = RMS, if span/(# of points in sweep) \leq (RBW/2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

Averaging type = power (i.e., RMS).

- 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
- 2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.

Sweep time = auto.

Perform a trace average of at least 100 traces.

Case 2

If continuous transmission of the EUT (i.e., duty cycle ≥ 98 percent) cannot be achieved and the duty cycle is not constant (i.e., duty cycle variations exceed ± 2 percent), then the following procedure shall be used:

Set RBW = 1 MHz.

Set VBW $\geq 1/T$.

Video bandwidth mode or display mode

- 1) The instrument shall be set to ensure that video filtering is applied in the power domain. Typically, this requires setting the detector mode to RMS and setting the Average-VBW Type to Power (RMS).
- 2) As an alternative, the instrument may be set to linear detector mode. Ensure that video filtering is applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode in order to accomplish this. Others have a setting for Average-VBW Type, which can be set to "Voltage" regardless of the display mode.

Detector = Peak.

Sweep time = auto.

Trace mode = max hold.

Allow max hold to run for at least 50 times (1/duty cycle) traces.

Note :

1. We used the case 1 for Zigbee mode to perform the average field strength measurements for RSE and radiated band edge test.

FCC PT.15.247 TEST REPORT		FCC CERTIFICATION REPORT		www.hct.co.kr
Test Report No. HCTR1309FR01-2	Date of Issue: September 13, 2013	EUT Type: INDOOR AIRQUALITY MONITOR		FCC ID: X6VMFA-200

TEST RESULTS

9 kHz – 30MHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dB μ V/m	dBm /m	dBm	(H/V)	dB μ V/m	dB μ V/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

TEST RESULTS

Below 1 GHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dB μ V/m	dBm /m	dBm	(H/V)	dB μ V/m	dB μ V/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

Above 1 GHz

Internal Antenna

Operation Mode: CH Low

Frequency [MHz]	Reading [dBuV/m]	AN.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4824	56.49	-4.48	V	52.01	74	21.97	PK
4824	49.32	-4.48	V	44.84	54	9.14	AV
7236	46.08	7.60	V	53.68	74	20.30	PK
7236	33.67	7.60	V	41.27	54	12.71	AV
4824	60.21	-4.48	H	55.73	74	18.25	PK
4824	54.51	-4.48	H	50.03	54	3.95	AV
7236	45.00	7.60	H	52.60	74	21.38	PK
7236	33.43	7.60	H	41.03	54	12.95	AV

Operation Mode: CH Mid

Frequency [MHz]	Reading [dBuV/m]	AN.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4874	57.33	-4.42	V	52.91	74	21.07	PK
4874	51.05	-4.42	V	46.63	54	7.35	AV
7311	45.97	7.38	V	53.35	74	20.63	PK
7311	33.58	7.38	V	40.96	54	13.02	AV
4874	58.17	-4.42	H	53.75	74	20.23	PK
4874	51.76	-4.42	H	47.34	54	6.64	AV
7311	46.40	7.38	H	53.78	74	20.20	PK
7311	33.63	7.38	H	41.01	54	12.97	AV

Operation Mode: CH High

Frequency [MHz]	Reading [dBuV/m]	AN.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4924	59.85	-4.43	V	55.42	74	18.56	PK
4924	53.85	-4.43	V	49.42	54	4.56	AV
7386	45.72	7.28	V	53.00	74	20.98	PK
7386	33.36	7.28	V	40.64	54	13.34	AV
4924	57.78	-4.43	H	53.35	74	20.63	PK
4924	51.20	-4.43	H	46.77	54	7.21	AV
7386	45.23	7.28	H	52.51	74	21.47	PK
7386	33.31	7.28	H	40.59	54	13.39	AV

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

External Antenna(Straight)

Operation Mode: CH Low

Frequency [MHz]	Reading [dBuV/m]	AN.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4824	62.06	-4.48	V	57.58	74	16.40	PK
4824	56.17	-4.48	V	51.69	54	2.29	AV
4824	59.62	-4.48	H	55.14	74	18.84	PK
4824	52.33	-4.48	H	47.85	54	6.13	AV

Operation Mode: CH Mid

Frequency [MHz]	Reading [dBuV/m]	AN.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4874	57.53	-4.42	V	53.11	74	20.87	PK
4874	50.65	-4.42	V	46.23	54	7.75	AV
4874	54.78	-4.42	H	50.36	74	23.62	PK
4874	46.99	-4.42	H	42.57	54	11.41	AV

Operation Mode: CH High

Frequency [MHz]	Reading [dBuV/m]	AN.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4924	56.16	-4.43	V	51.73	74	22.25	PK
4924	48.26	-4.43	V	43.83	54	10.15	AV
4924	53.02	-4.43	H	48.59	74	25.39	PK
4924	45.00	-4.43	H	40.57	54	13.41	AV

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

External Antenna(Refracted)

Operation Mode: CH Low

Frequency [MHz]	Reading [dBuV/m]	AN.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4810	61.21	-4.48	V	56.73	74	17.25	PK
4810	56.00	-4.48	V	51.52	54	2.46	AV
4810	58.13	-4.48	H	53.65	74	20.33	PK
4810	50.99	-4.48	H	46.51	54	7.47	AV

Operation Mode: CH Mid

Frequency [MHz]	Reading [dBuV/m]	AN.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4890	58.77	-4.42	V	54.35	74	19.63	PK
4890	52.53	-4.42	V	48.11	54	5.87	AV
4890	55.33	-4.42	H	50.91	74	23.07	PK
4890	47.69	-4.42	H	43.27	54	10.71	AV

Operation Mode: CH High

Frequency [MHz]	Reading [dBuV/m]	AN.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4940	57.46	-4.43	V	53.03	74	20.95	PK
4940	50.49	-4.43	V	46.06	54	7.92	AV
4940	53.99	-4.43	H	49.56	74	24.42	PK
4940	45.13	-4.43	H	40.70	54	13.28	AV

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

8.6.2 RADIATED RESTRICTED BAND EDGES

Test Requirements and limit, §15.247(d) §15.205, §15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions 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) (See section 15.205(c)).

Internal Antenna

Operation Mode	Zigbee Mode
Operating Frequency	2405 MHz, 2470 MHz
Channel No	11 Ch, 24 Ch

Frequency [MHz]	Reading [dBuV/m]	A.F.+CL [dBm]	Ant. Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
2390.0	25.27	31.47	H	56.74	74	17.24	PK
2390.0	13.80	31.47	H	45.27	54	8.71	AV
2390.0	24.57	31.47	V	56.04	74	17.94	PK
2390.0	13.46	31.47	V	44.93	54	9.05	AV
2483.5	25.98	31.46	H	57.44	74	16.54	PK
2483.5	14.42	31.46	H	45.88	54	8.10	AV
2483.5	24.42	31.46	V	55.88	74	18.10	PK
2483.5	13.18	31.46	V	44.64	54	9.34	AV

External Antenna(Straight)

Operation Mode	Zigbee Mode
Operating Frequency	2405 MHz, 2470 MHz
Channel No	11 Ch, 24 Ch

Frequency [MHz]	Reading [dBuV/m]	A.F.+CL [dBm]	Ant. Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
2390.0	26.35	31.47	H	57.82	74	16.16	PK
2390.0	14.57	31.47	H	46.04	54	7.94	AV
2390.0	25.98	31.47	V	57.45	74	16.53	PK
2390.0	14.03	31.47	V	45.50	54	8.48	AV
2483.5	26.32	31.46	H	57.78	74	16.20	PK
2483.5	15.08	31.46	H	46.54	54	7.44	AV
2483.5	26.00	31.46	V	57.46	74	16.52	PK
2483.5	14.88	31.46	V	46.34	54	7.64	AV

External Antenna(Refracted)

Operation Mode	Zigbee Mode
Operating Frequency	2405 MHz, 2470 MHz
Channel No	11 Ch, 24 Ch

Frequency [MHz]	Reading [dBuV/m]	A.F.+CL [dBm]	Ant. Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
2390.0	26.02	31.47	H	57.49	74	16.49	PK
2390.0	14.75	31.47	H	46.22	54	7.76	AV
2390.0	25.58	31.47	V	57.05	74	16.93	PK
2390.0	14.06	31.47	V	45.53	54	8.45	AV
2483.5	27.42	31.46	H	58.88	74	15.10	PK
2483.5	15.55	31.46	H	47.01	54	6.97	AV
2483.5	26.78	31.46	V	58.24	74	15.74	PK
2483.5	14.98	31.46	V	46.44	54	7.54	AV

Notes:

1. Total = Reading Value + Antenna Factor + Cable Loss
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

8.7 POWERLINE CONDUCTED EMISSIONS

Test Requirements and limit, §15.207

For an intentional radiator which is designed to be connected to the public utility (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 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.
5. We are performed the AC Power Line Conducted Emission test for Ch.24 on Zigbee mode.
Because Ch.24 on Zigbee mode is worst case.

RESULT PLOTS

Conducted Emissions (Line 1)

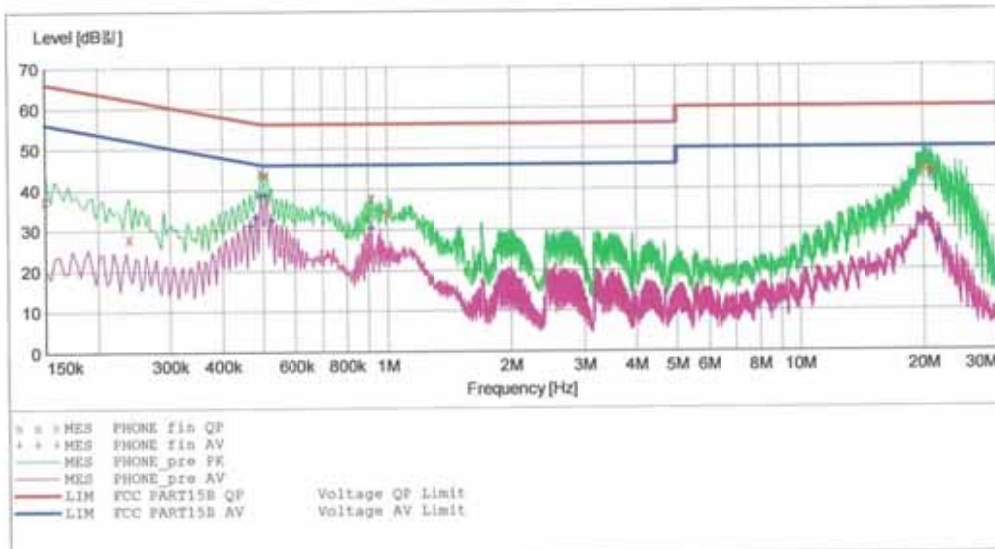
HCT

EMC

EUT: MFA-200
Manufacturer: Maxfor
Operating Condition: Zigbee mode
Test Site: SHIELD ROOM
Operator: JS LEE
Test Specification: FCC PART15 B
Comment: H

SCAN TABLE: "FCC CLASS B(H)"

Short Description:			KN22 CLASS B			
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
150.0 kHz	500.0 kHz	4.0 kHz	MaxPeak	10.0 ms	9 kHz	None
			Average			
500.0 kHz	5.0 MHz	4.0 kHz	MaxPeak	10.0 ms	9 kHz	None
			Average			
5.0 MHz	30.0 MHz	4.0 kHz	MaxPeak	10.0 ms	9 kHz	None
			Average			



MEASUREMENT RESULT: "PHONE_fin QP"

2013-09-06 9:31오전

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.150001	37.40	9.8	66	28.6	---	---
0.238001	28.00	9.8	62	34.2	---	---
0.494001	44.30	9.8	56	11.8	---	---
0.508000	43.70	9.8	56	12.3	---	---
0.916000	37.90	9.8	56	18.1	---	---
1.004000	34.10	9.8	56	21.9	---	---
20.052000	44.90	10.9	60	15.1	---	---
20.816000	43.70	11.0	60	16.3	---	---
20.948000	43.60	11.0	60	16.4	---	---

MEASUREMENT RESULT: "PHONE_fin AV"

2013-09-06 9:31오전

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.466001	31.10	9.8	47	15.4	---	---
0.482001	33.20	9.8	46	13.1	---	---
0.494001	38.40	9.8	46	7.7	---	---
0.508000	38.50	9.8	46	7.5	---	---
0.524000	32.40	9.8	46	13.6	---	---
0.916000	30.40	9.8	46	15.6	---	---
20.048000	31.80	10.9	50	18.2	---	---
21.592000	26.40	11.0	50	23.6	---	---
21.732000	26.80	11.0	50	23.2	---	---

Conducted Emissions (Line 2)

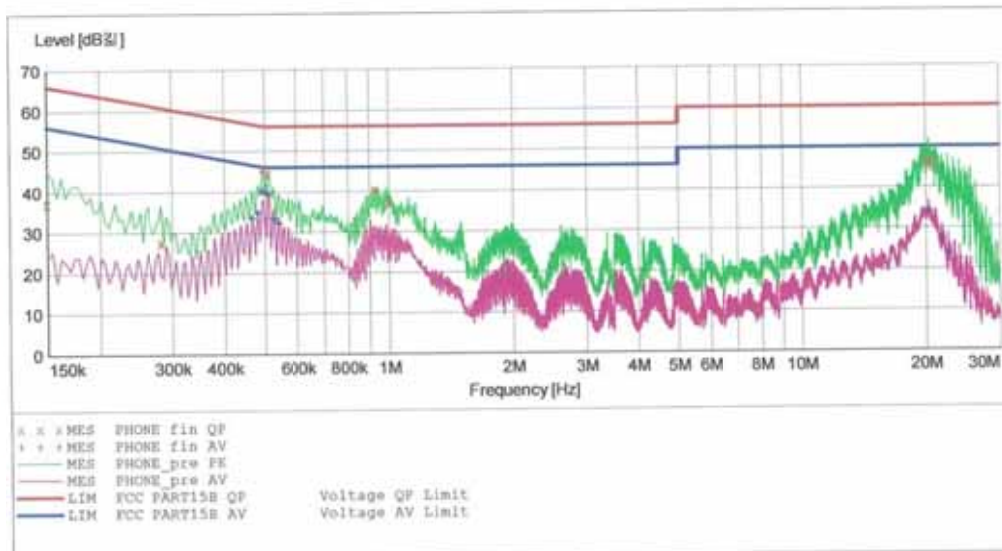
HCT

EMC

EUT: MFA-200
Manufacturer: Maxfor
Operating Condition: Zigbee MODE
Test Site: SHIELD ROOM
Operator: JS LEE
Test Specification: FCC PART15 B
Comment: N

SCAN TABLE: "FCC CLASS B(N)"

Short Description:			KN22 CLASS B			
Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	500.0 kHz	4.0 kHz	MaxPeak	10.0 ms	9 kHz	None
			Average			
500.0 kHz	5.0 MHz	4.0 kHz	MaxPeak	10.0 ms	9 kHz	None
			Average			
5.0 MHz	30.0 MHz	4.0 kHz	MaxPeak	10.0 ms	9 kHz	None
			Average			



MEASUREMENT RESULT: "PHONE_fin QP"

2013-09-06 9:37오전

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.150001	37.30	10.0	66	28.7	---	---
0.282001	27.60	10.0	61	33.2	---	---
0.494001	45.90	10.0	56	10.2	---	---
0.508000	44.40	10.0	56	11.6	---	---
0.932000	40.30	10.0	56	15.7	---	---
1.004000	37.20	10.1	56	18.8	---	---
20.256000	46.20	11.3	60	13.8	---	---
20.336000	46.70	11.3	60	13.3	---	---
21.064000	45.30	11.3	60	14.7	---	---

MEASUREMENT RESULT: "PHONE_fin AV"

2013-09-06 9:37오전

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.466001	33.30	10.0	47	13.3	---	---
0.482001	34.70	10.0	46	11.6	---	---
0.494001	40.10	10.0	46	6.0	---	---
0.508000	39.40	10.0	46	6.6	---	---
0.524000	33.40	10.0	46	12.6	---	---
0.540000	32.10	10.0	46	13.9	---	---
20.240000	33.90	11.3	50	16.1	---	---
21.800000	27.00	11.3	50	23.0	---	---
22.548000	23.60	11.4	50	26.4	---	---

9. LIST OF TEST EQUIPMENT

Manufacturer	Model / Equipment	Calibration Interval	Calibration Due	Serial No.
Rohde & Schwarz	ENV216/ LISN	Annual	02/06/2014	100073
Schwarzbeck	VULB 9160/ TRILOG Antenna	Biennial	12/17/2014	3150
Rohde & Schwarz	ESI 40 / EMI TEST RECEIVER	Annual	04/16/2014	831564103
Agilent	E4440A/ Spectrum Analyzer	Annual	04/25/2014	US45303008
Agilent	N9020A/ SIGNAL ANALYZER	Annual	05/14/2014	MY51110063
HD	MA240/ Antenna Position Tower	N/A	N/A	556
EMCO	1050/ Turn Table	N/A	N/A	114
HD GmbH	HD 100/ Controller	N/A	N/A	13
HD GmbH	KMS 560/ SlideBar	N/A	N/A	12
Rohde & Schwarz	SCU-18/ Signal Conditioning Unit	Annual	09/11/2013	10094
MITEQ	AMF-6B-180265-35-10P / POWER AMP	Annual	04/16/2014	667624
CERNEX	CBL26405040 / POWER AMP	Annual	04/16/2014	19660
Schwarzbeck	BBHA 9120D/ Horn Antenna	Biennial	10/17/2013	937
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	Biennial	10/30/2014	BBHA9170124
Rohde & Schwarz	FSP / Spectrum Analyzer	Annual	02/08/2014	839117/011
Agilent	E4416A /Power Meter	Annual	11/07/2013	GB41291412
Agilent	E9327A /POWER SENSOR	Annual	04/16/2014	MY4442009
Wainwright Instrument	WHF3.0/18G-10EF / High Pass Filter	Annual	02/08/2014	F6
Wainwright Instrument	WHNX6.0/26.5G-6SS / High Pass Filter	Annual	04/16/2014	1
Wainwright Instrument	WHNX7.0/18G-8SS / High Pass Filter	Annual	04/16/2014	29
Wainwright Instrument	WRCJ2400/2483.5-2370/2520-60/14SS / Band Reject Filter	Annual	03/19/2014	1
Hewlett Packard	11636B/Power Divider	Annual	11/07/2013	11377
Agilent	87300B/Directional Coupler	Annual	12/24/2013	3116A03621
Hewlett Packard	11667B / Power Splitter	Annual	05/29/2014	05001
DIGITAL	EP-3010 /DC POWER SUPPLY	Annual	11/07/2013	3110117
ITECH	IT6720 / DC POWER SUPPLY	Annual	11/07/2013	010002156287001199
TESCOM	TC-3000C / BLUETOOTH TESTER	Annual	04/24/2014	3000C000276
Rohde & Schwarz	CBT / BLUETOOTH TESTER	Annual	04/25/2014	100422
EMCO	6502.LOOP ANTENNA	Biennial	01/11/2014	9009-2536
CERNEX	CBLU1183540 / POWER AMP	Annual	07/24/2014	21691
Agilent	8493C / Attenuator(10 dB)	Annual	07/24/2014	76649
WEINSCHL	2-3 / Attenuator(3 dB)	Annual	11/07/2013	BR0617