TEST REPORT

Part 15 Subpart C 15.249

Equipment under test Occupancy Sensor

Model name OSRF-STUS

FCC ID TSW-OSRFSTUS

Applicant Samjin LND

Manufacturer Samjin LND

Date of test(s) 2014.03.07 ~2014.03.20

Date of issue 2014.04.04

Issued to

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Revision history

Revision	Date of issue	Test report No.	Description
-	2014.04.04	KES-RF-14T0016	Initial

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1. General information

1.1. EUT description

Equipment under test	Occupancy Sensor
Model name	OSRF-STUS
Serial number	N/A
Frequency range	917.1 ㎒ ~ 923.3 ㎒
Modulation technique	FSK
Number of channels	32
Antenna type & gain	Fixed type(Helical antenna) // 1 dBi
Power source	DC 5 V

1.2. Test frequency

- 802.11b/g/n_HT20

	Low channel	**Middle channel**	**High channel**
Frequency (㎒)	917.1	920.3	923.3

1.3. Information about derivative model

N/A

1.4. Device modifications

N/A

1.5 Device information

- The device duty cycle ≥ 98 percent

1.6. Test facility

C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do,431-716, Korea
473-29, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea

The open area test site is constructed in conformance with the requirements ANSI C63.4-2003/2009.

1.7. Laboratory accreditations and listings

Country	Agency	Scope of accreditation	Certificate No.
USA	FCC	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	343818
KOREA	KC	EMI (10 meter Open Area Test Site and two conducted sites) Radio (3 & 10 meter Open Area Test Sites and one conducted site)	KR0100
CANADA	IC	3 & 10 meter Open Area Test Sites and one conducted site	4769B-1

2. Summary of tests

Reference	Parameter	Test results
15.249(a)	Field strength of fundamental	Pass
15.205 15.209 15.249(d)	Radiated spurious emission, Out-of-band emission	Pass
15.215(c)	20 dB bandwidth	Pass
15.207	AC conducted emissions	Pass

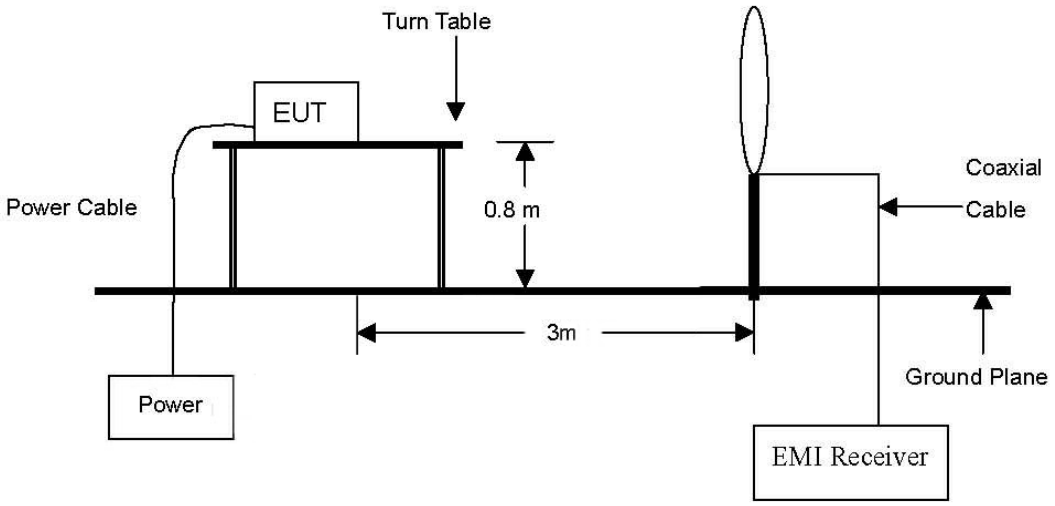
Test procedures;
The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 ㎑ to 40 ㎓ (ANSI C63.4-2003/2009) were used in the measurement of the EUT.

3. Test results

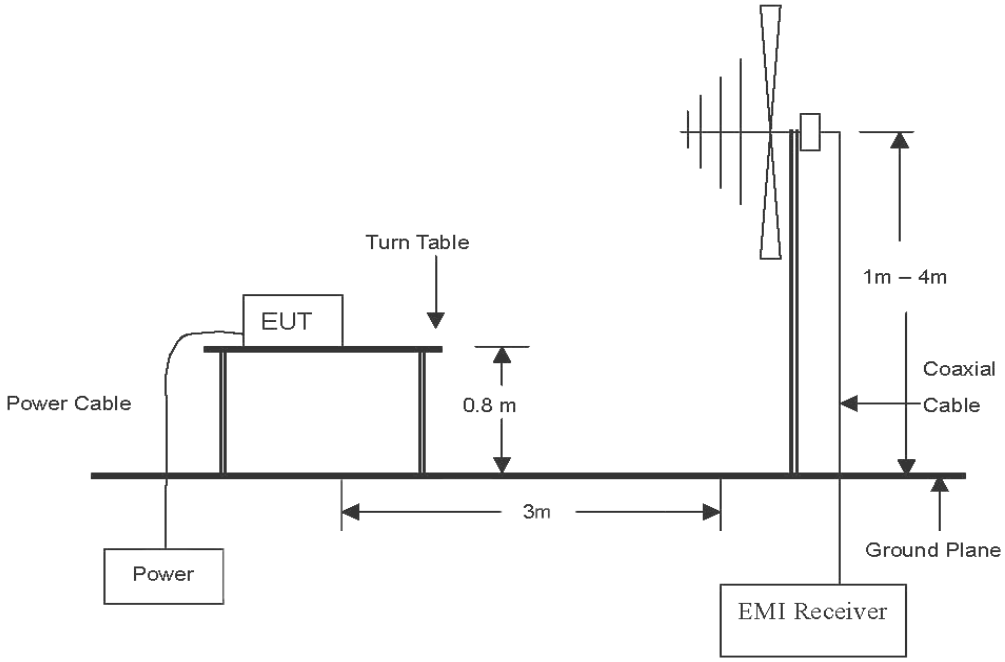
3.1 Field strength of fundamental & Radiated spurious emission & Out-of-band emission

Test setup

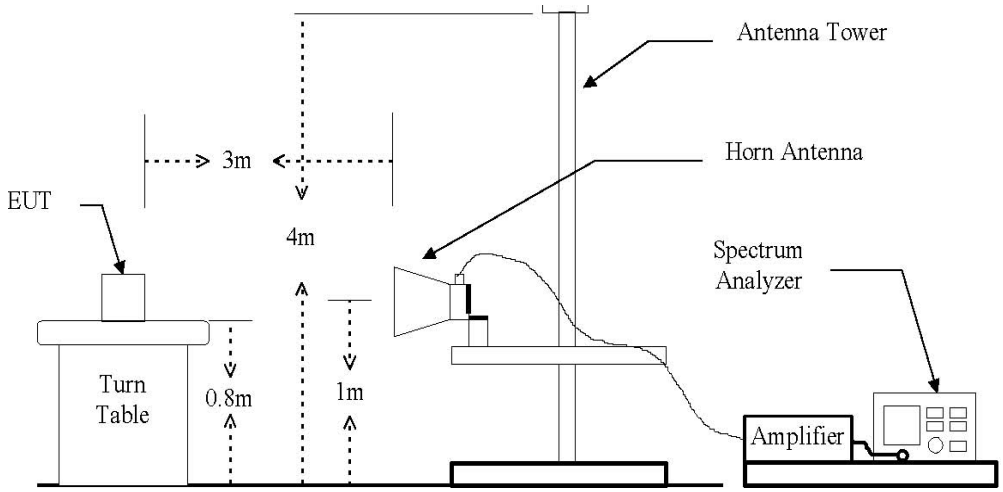
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to 40 ㎓ emissions.



Test procedure

Radiated emissions from the EUT were measured according to the dictates in section 8 & 13 of ANSI C63.4-2009

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site or open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference receiving antenna.
3. The antenna is a broadband antenna, and its height is varied from 1 meter to 4 meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test receiver system was set to peak detect function and specified bandwidth with maximum hold mode.
6. If the emission level of the EUT in peak mode was 10 ㏈lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have10 ㏈ margin would be retested one by one using peak,quasi-peak or average method as specified and then reported in a data sheet

Note.
The spectrum analyzer is set to:

[9 ㎑ to 30 ㎒]
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 ㎐ for Quasi-peak detection (QP) at frequency below 9 ㎑~ 150 ㎑.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 ㎑ for Quasi-peak detection (QP) at frequency below 150 ㎑~ 30 ㎒.

[30 ㎒ to 1 ㎓ and 1 ㎓ to 10 ㎓]
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ and video bandwidth is 1 ㎒ for Peak detection at frequency above 1 ㎓.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is 10 ㎐ for Average detection (AV) at frequency above 1 ㎓.

To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes.

Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2 400 / F(㎑)
0.490 ~ 1.705	30	24 000 / F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 ㎒, 76 ~ 88 ㎒, 174 ~ 216 ㎒ or 470 ~ 806 ㎒. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

According to 15.249(a)

Fundamental frequency	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBuV/m	uV/m	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	108	2500	68

According to 15.249(d)

Emission radiated outside of the specified frequency bands, except harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limit in FCC part 15C, Section 15.209, whichever is the lesser attenuation.

Test result (Fundamental)

Low Channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
917.08	58.13	QP	H	23.57	8.42	90.12	94	3.88
917.11	58.65	QP	V	23.57	8.42	90.64	94	3.36

Middle Channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
920.32	58.63	QP	H	23.65	8.43	90.71	94	3.29
920.31	58.68	QP	V	23.65	8.43	90.76	94	3.24

High Channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
923.28	58.61	QP	H	23.73	8.45	90.79	94	3.21
923.32	58.88	QP	V	23.73	8.45	91.06	94	2.94

1. Radiated emissions measured in fundamental frequency were made with an instrument using Quasi peak detector mode.
2. Actual = Reading + Ant. factor + Cable loss
3. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

Test results (Spurious emission Below 30 ㎒)

The frequency spectrum from 9 ㎑ to 30 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 20 ㏈.

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Pol.	Ant. factor (㏈/m)	Cable loss (㏈)	F_d (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
Not detected for above 30 ㎒								

Note.

1. All spurious emission at channels are almost the same below 30 ㎒, so that high channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss + F_d
3. $F_d = 40\log(D_m / D_s)$

   Where:

   F_d = Distance factor in ㏈

   D_m = Measurement distance in meters

   D_s = Specification distance in meters

Test results (Spurious emission Below 1 000 ㎒)

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated.

Low Channel

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
260.3	17.50	V	12.09	3.59	33.34	46.0	12.66
481.1	12.29	H	17.34	5.47	34.23	46.0	11.77
561.1	17.78	H	18.89	5.91	42.94	46.0	3.06
599.8	11.04	H	19.61	6.10	37.65	46.0	8.35

Middle Channel

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
260.1	17.51	V	12.08	3.59	33.18	46.0	12.82
481.1	12.39	H	17.34	5.47	35.20	46.0	10.80
561.1	17.78	H	18.89	5.91	42.58	46.0	3.42
599.8	11.04	H	19.61	6.10	36.75	46.0	9.25

High Channel

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
260.3	16.46	V	12.09	3.59	32.14	46.0	13.86
481.1	13.97	H	17.34	5.47	36.78	46.0	9.22
519.9	18.96	H	18.12	5.70	42.78	46.0	3.22
561.1	12.87	H	18.89	5.91	37.67	46.0	8.33

※ Remark

1. Actual = Reading + Ant. factor + Cable loss
2. Detector mode: Quasi peak
3. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

Test results (Spurious emission Above 1 000 ㎒)

The frequency spectrum from 1 ㎓ to 10 ㎓ was investigated.

Low channel

Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1 196.2	50.57	PK	H	-5.54	45.03	74.00	28.97
1 200.9	51.89	PK	V	-5.49	46.40	74.00	27.60
1 496.1	49.92	PK	H	-2.47	47.45	74.00	26.55
1 496.1	50.26	PK	V	-2.47	47.79	74.00	26.21

Middle channel

Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1 196.6	49.12	PK	H	-5.54	43.58	74.00	30.42
1 201.3	50.79	PK	V	-5.49	45.30	74.00	28.70
1 496.1	50.34	PK	H	-2.47	47.87	74.00	26.13
1 496.7	51.34	PK	V	-2.47	48.87	74.00	25.13

High channel

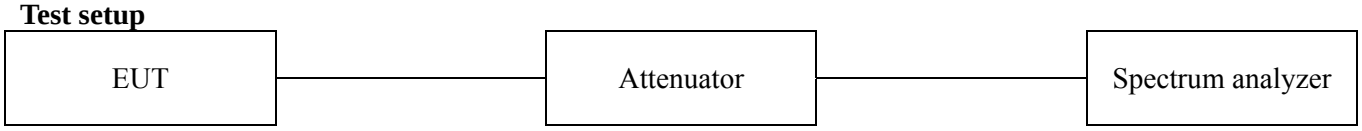
Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1 196.6	48.67	PK	H	-5.54	43.13	74.00	30.87
1 200.7	50.05	PK	V	-5.49	44.56	74.00	29.44
1 495.7	51.74	PK	H	-2.47	49.27	74.00	24.73
1 495.9	51.18	PK	V	-2.47	48.71	74.00	25.29

※ Remark

1. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + AFCL(Ant. factor – Amp. gain + Cable loss)
5. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

3.2 20 dB bandwidth

Test setup



Test procedure

1. Use the following spectrum analyzer setting
   Center frequency: Lowest, middle and highest channels
   RBW = 1 ㎑
   VBW = 3 ㎑ (≥3xRBW)
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

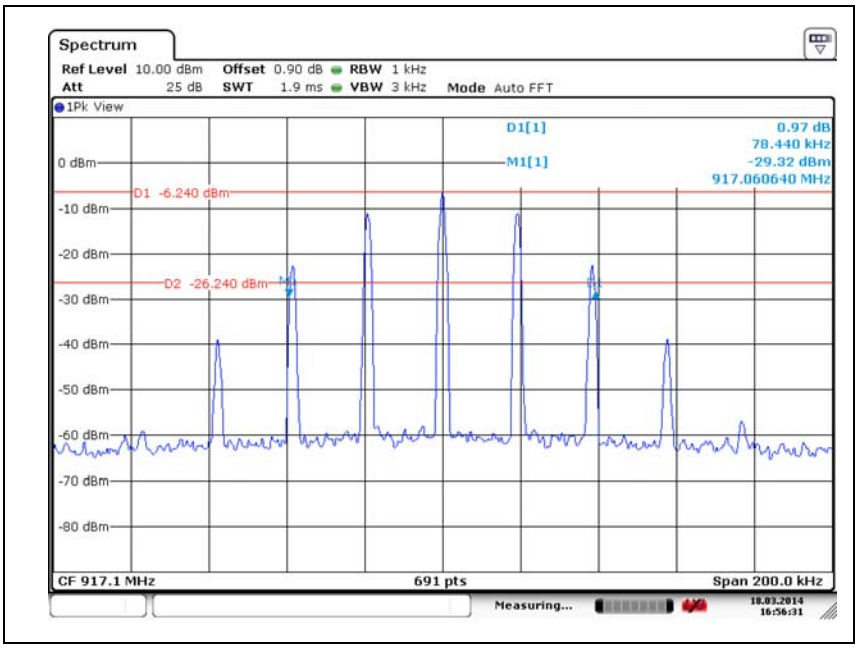
Limit

Not applicable

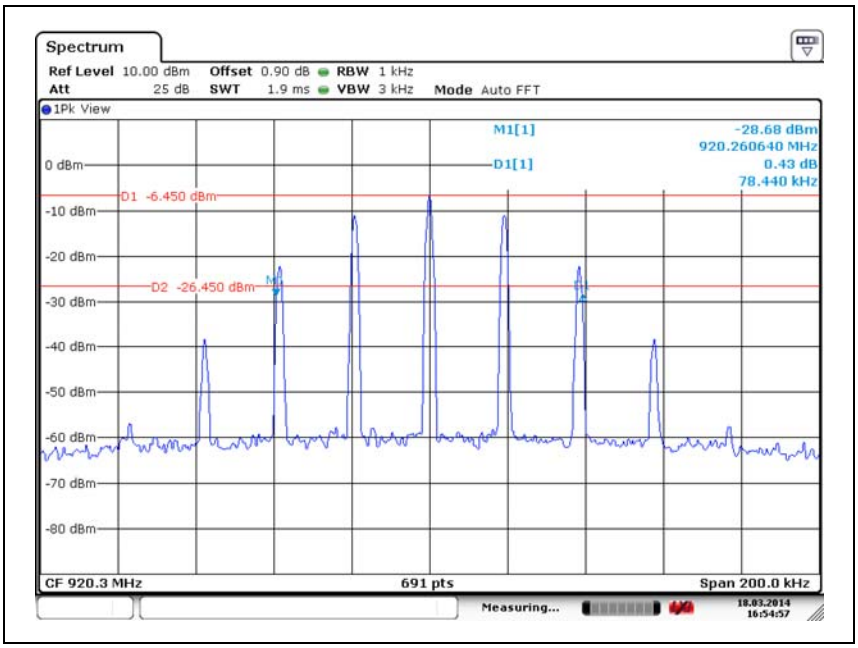
Test results

Operation mode	Frequency(㎒)	20 ㏈ bandwidth(㎒)	Limit
Transmission	917.1	0.078	-
	920.3	0.078	-
	923.3	0.078	-

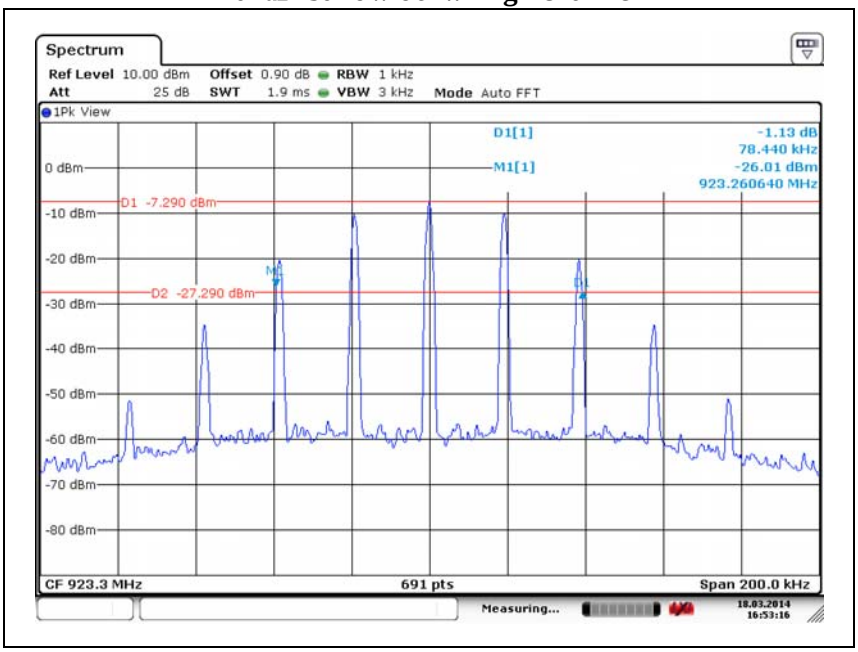
20 ㏈ bandwidth // Low channel



20 dB bandwidth // Middle channel



20 dB bandwidth // High channel



3.3. AC conducted emissions

Frequency range of measurement
150 ㎑ to 30 ㎒

Instrument settings
IF Band Width: 9 ㎑

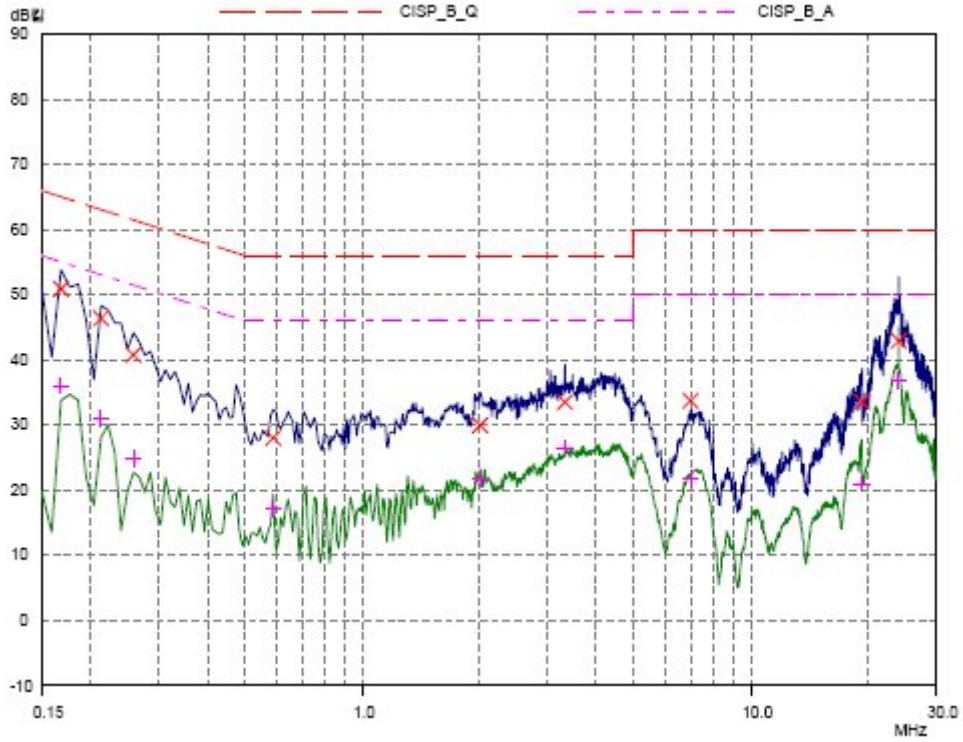
Test procedures
The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m. Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit
According to 15.207(a), for an intentional radiator that 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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (㎒)	Conducted limit (dB㎶/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

Note.
a) Decreases with the logarithm of the frequency.
b) Worst case configuration: 802.11 g
c) All AC Conducted emission at channels are almost the same, so that high channel was chosen at representative in final test.

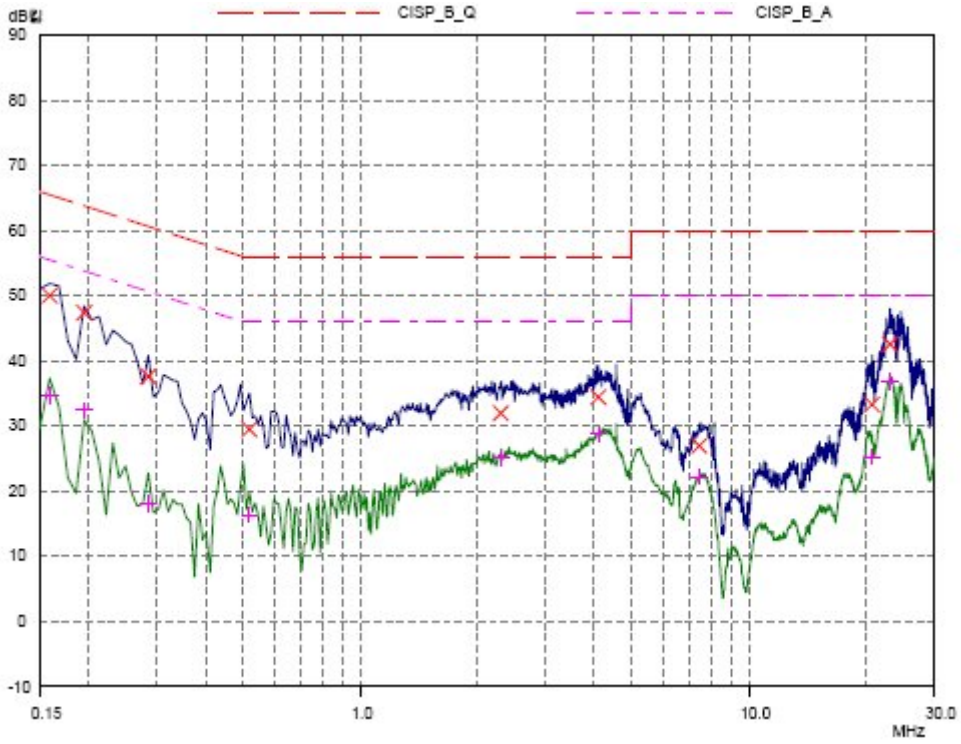
Test results



Frequency MHz	QP Level dBµV	QP Limit dBµV	QP Delta dB
0.168	50.92	65.06	14.14
0.213	46.39	63.09	16.70
0.258	40.82	61.50	20.68
0.591	27.98	56.00	28.02
2.013	29.98	56.00	26.02
3.327	33.53	56.00	22.47
6.998	33.76	60.00	26.24
19.337	33.51	60.00	26.49
24.035	42.96	60.00	17.04

Frequency MHz	AV Level dBµV	AV Limit dBµV	AV Delta dB
0.168	36.02	55.06	19.04
0.213	30.93	53.09	22.16
0.258	24.91	51.50	26.59
0.591	17.10	46.00	28.90
2.013	21.84	46.00	24.16
3.327	26.52	46.00	19.48
6.998	21.85	50.00	28.15
19.337	20.97	50.00	29.03
24.035	36.82	50.00	13.18

Note; Hot Line
Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).



Frequency MHz	QP Level dBµV	QP Limit dBµV	QP Delta dB
0.159	50.03	65.52	15.49
0.195	47.39	63.82	16.43
0.265	37.62	60.67	23.05
0.519	29.48	56.00	26.52
2.301	32.00	56.00	24.00
4.101	34.44	56.00	21.56
7.457	26.96	60.00	33.04
20.768	33.32	60.00	26.68
23.09	42.59	60.00	17.41

Frequency MHz	AV Level dBµV	AV Limit dBµV	AV Delta dB
0.159	34.68	55.52	20.84
0.195	32.40	53.82	21.42
0.265	18.03	50.67	32.64
0.519	16.37	46.00	29.63
2.301	25.09	46.00	20.91
4.101	28.77	46.00	17.23
7.457	22.22	50.00	27.78
20.768	25.31	50.00	24.69
23.09	36.81	50.00	13.19

Note; Neutral Line
Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).

Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV30	101389	1 year	2015.05.06
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2014.05.06
Brodband coaxial preamplifier	Schwarzbeck Mess-Elektronik	BB9718	9168-385	2 years	2014.09.23
Preamplifier	Schwarzbeck Mess-Elektronik	BBV-571	781	1 year	2014.09.23
Loop Antenna	R&S	HFH2-Z2.335.4711.52	826532	2 years	2015.04.25
Trilog-broadband antenna	Schwarzbeck	VULB 9168	9168-385	2 years	2015.05.09
Horn antenna	A.H.	SAS-571	414	2 years	2015.02.28
Horn antenna	A.H.	SAS-572	269	2 years	2015.09.07
EMI Test Receiver	LIG NEX1	ISA-80	L0912K014	1 year	2014.11.15
EMI Test Receiver	R & S	ESVS10	826008/014	1 year	2014.04.09
EMI Test Receiver	R & S	ESHS10	862970/018	1 year	2014.05.06
LISN	SCHWARZBECK	2823-568-1	8126157	1 year	2015.01.29
HIGH PASS FILTER	WEINSCHEL	WHKX1.2/15G-6TT	1	1 year	2014.08.05
BAND REJECT FILTER	K&L	3TNF-500/1000-N/N	399	1 year	2014.11.13

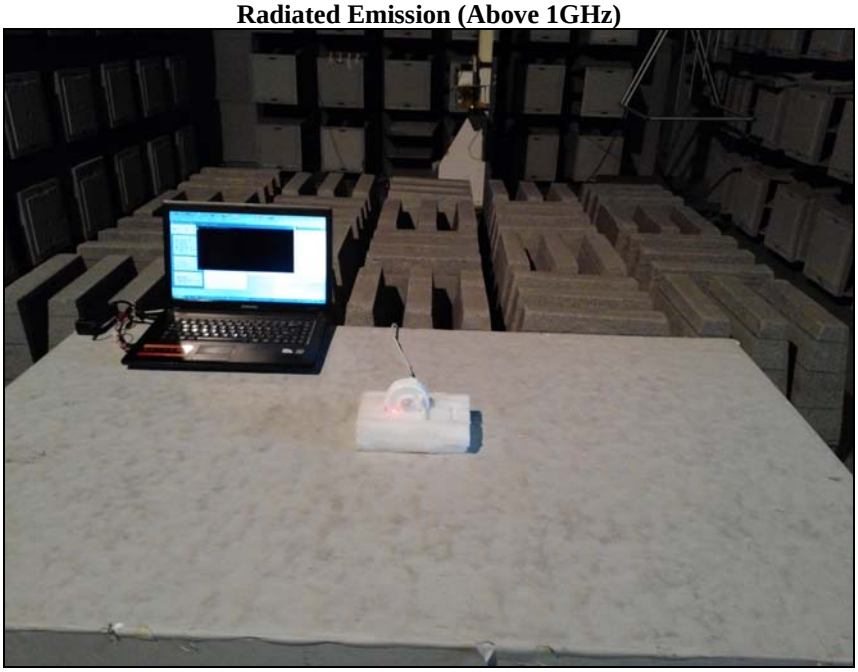
Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook(Laptop)	Samsung Electronics	NT-R519	ZKPA93ES900086Z

Appendix B. Test setup photo

Radiated Emission (30MHz~1GHz)

Radiated Emission (Above 1GHz)



AC conducted Emission