TEST REPORT

Part 15E

Equipment under test	System Control Unit
Model name	FXRS-03A
FCC ID	PFRFXRS-03A
Trade mark	vieworks
Applicant	Vieworks Co., Ltd.
Manufacturer	Vieworks Co., Ltd.
Date of test(s)	2015.01.19 ~ 2015.01.23
Date of issue	2015.01.29

Issued to

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Revision history

Revision	Date of issue	Test report No.	Description
-	2015.01.29	KES-RF-15T0006	Initial

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1. General information

1.1. EUT description

Equipment under test	System Control Unit
Model name	FXRS-03A
Serial number	N/A
Frequency range	2 412 ㎒ ~ 2 462 ㎒(802.11b/g/n_HT20), 2 422 ㎒ ~ 2 452 ㎒(802.11n_HT40) 5 745 ㎒ ~ 5 825 ㎒(802.11a/n_HT20), 5 755 ㎒ ~ 5 795 ㎒(802.11n_HT40) 5 180 ㎒ ~ 5 240 ㎒(802.11a/n_HT20), 5 190 ㎒ ~ 5 230 ㎒(802.11n_HT40)
Modulation technique	CCK(dBPSK, DQPSK), OFDM (BPSK, QPSK, 16QAM, 64QAM)
Number of channels	2 412 ㎒ ~ 2 462 ㎒(802.11b/g/n_HT20) : 11 ch 2 422 ㎒ ~ 2 452 ㎒(802.11n_HT40) : 7 ch 5 745 ㎒ ~ 5 825 ㎒(802.11a/n_HT20) : 5 ch 5 755 ㎒ ~ 5 795 ㎒(802.11n_HT40) : 2 ch 5 180 ㎒ ~ 5 240 ㎒(802.11a/n_HT20) : 4 ch 5 190 ㎒ ~ 5 230 ㎒(802.11n_HT40) : 2 ch
Antenna type	Dipole antenna(SMA)
Power source	120 V ac / 60 ㎐
Note	Contains transmitter Module. (FCC ID : RYK-WPEA-121N) - Contains transmitter Module does not use DFS band. - Duty cycle is > 98%

1.2. Test frequency

	Low channel	**Middle channel**	**High channel**	**Mode**
Frequency (㎒)	5 180	5 220	5 240	802.11a/n_HT20
	5 190	-	5 230	802.11n_HT40

1.3. Information about derivative model

N/A

1.4. Device modifications

N/A

1.5 Device information

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

1.8. Directional antenna gain for MIMO (correlated)

Model : JK-450B

ANT1 Gain (dBi)	ANT2 Gain (dBi)	Total Gain (dBi)	Note
2.6	2.6	5.61	For 5.2 ㎓

-Ant Gain = G_{ANT} + 10 log(N)

2.1 Summary of tests

FCC Part Sections	Parameter	Test results
15.205 15.209	Radiated spurious emission	Pass
15.407(b)	Undesirable emission	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), the guidance provided in KDB 558074 D01 v03r02, KDB 662911 D01 v02r01 were used in the measurement of the EUT.

2.2 Worst-Case and Mode

The worst-case data rates are determined to be as follows for each mode, based on the investigations
by measuring the average power, peak power across all the data rates.
all tests were made with following data rates:

802.11a mode : 6 Mbps.
802.11n HT20 mode : MCS8.
802.11n HT40 mode : MCS8.

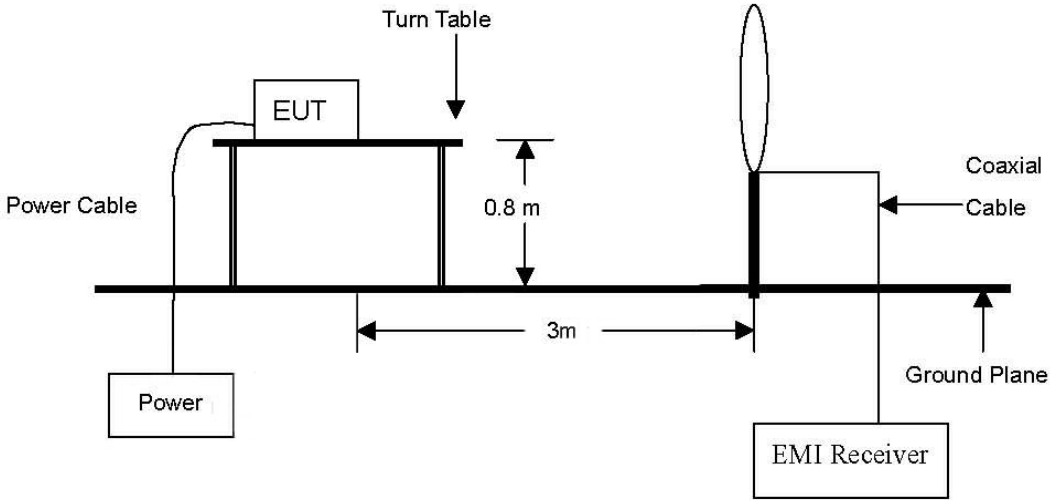
The EUT antenna has been tested in X, Y and Z axis.
The worst case position is Y-axis(below 1㎓), Y-axis(above 1㎓). Each axis were recorded in this report.

3. Test results

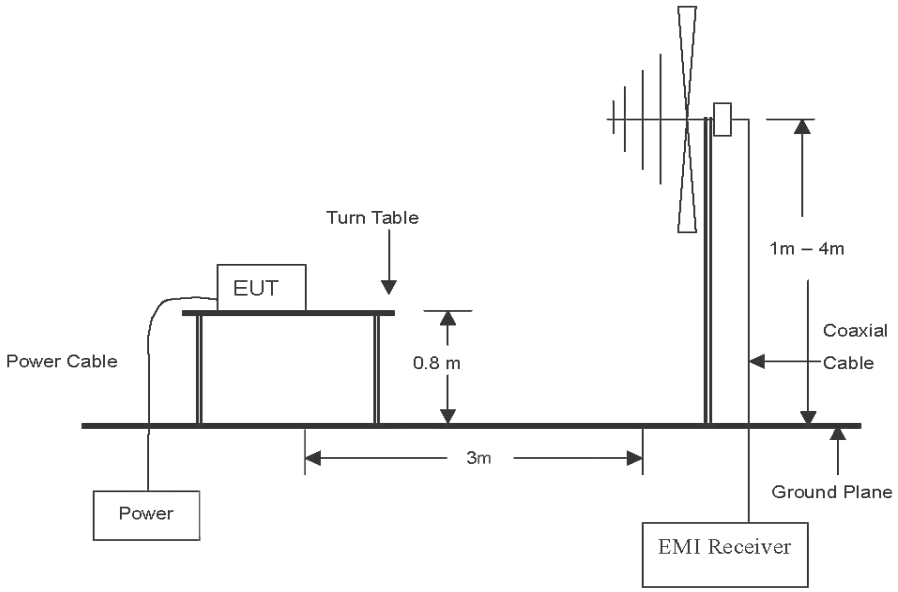
3.1 Radiated spurious emissions

Test setup

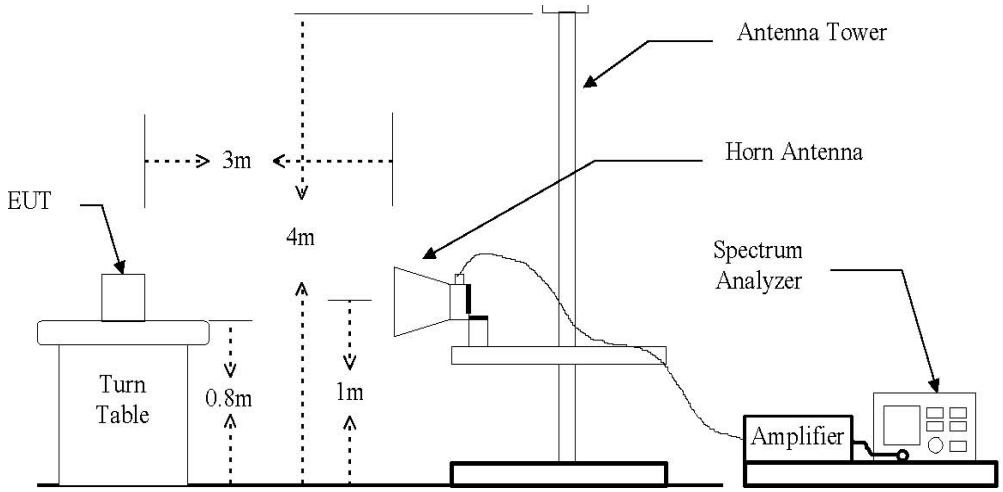
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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 12.0 of KDB 558074 D01 v03r02 and ANSI C63.4-2003/2009

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.
All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

The spectrum analyzer is set to:
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 ㎒.
3. 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 ㎓.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ and video bandwidth is 3 ㎒ for Peak detection at frequency above 1 ㎓.
5. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is 3 ㎒ for Average detection (AV) at frequency above 1 ㎓. (Detect mode: RMS(power), Averaging 100)

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 15.205(a), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

According to 15.205(b), Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 ㎒, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 ㎒, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

According to 15.407(b),
(b) Undesirable emission limits: Except as shown in paragraph (b)(6) of this section, the peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
(1) For transmitters operating in the 5.15–5.25 ㎓ band: all emissions outside of the 5.15–5.35 ㎓ band shall not exceed an EIRP of –27 ㏈m/㎒.
(2) For transmitters operating in the 5.25–5.35 ㎓ band: all emissions outside of the 5.15–5.35 ㎓ band shall not exceed an EIRP of –27 ㏈m/㎒. Devices operating in the 5.25–5.35 ㎓ band that generate emissions in the 5.15–5.25 ㎓ band must meet all applicable technical requirements for operation in the 5.15–5.25 ㎓ band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of –27 ㏈m/㎒ in the 5.15–5.25 ㎓ band.
(3) For transmitters operating in the 5.47–5.725 ㎓ band: all emissions outside of the 5.47–5.725 ㎓ band shall not exceed an EIRP of –27 ㏈m/㎒.
(4) For transmitters operating in the 5.725–5.825 ㎓ band: all emissions within the frequency range from the band edge to 10 ㎒ above or below the band edge shall not exceed an EIRP of –17 ㏈m/㎒; for frequencies 10 ㎒ or greater above or below the band edge, emissions shall not exceed an EIRP of –27 ㏈m/㎒.
(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 ㎒. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 ㎒.
(6) Unwanted emissions below 1 ㎓ must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.

*EIRP[dBm] = E[dBμV/m] - 95.2
EIRP of –27 ㏈m/㎒ = 68.3 ㏈㎶/m (3m)

Test results (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 below 30 ㎒								

Note.

1. All spurious emission at channels are almost the same below 30 ㎒, so that 802.11a 5180 ㎒ were 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 (Below 1 000 ㎒)

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 20 ㏈.

802.11a / 5180 ㎒

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Pol.	Ant. factor (㏈/m)	Cable loss (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
51.347	21.260	V	13.570	1.640	36.470	40.000	3.530
198.915	19.020	V	9.980	3.440	32.440	43.500	11.060
247.345	19.530	H	11.650	3.850	35.030	46.000	10.970

Note.

1. All spurious emission at channels are almost the same below 1 000 ㎒, so that 802.11a 5180 ㎒ were chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss
3. Detector mode: Quasi peak
4. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

Test results (Above 1 000 ㎒)

The frequency spectrum from 1 ㎓ to 25 ㎓ and 40 ㎓ was investigated. No Emissions were found above 20 ㏈ below the limit.

802.11a / 5180 ㎒

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	AFCL (㏈)	DCF (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
4807.76	34.59	PK	H	13.57	-	48.16	74.00	25.84
5000.04	38.76	PK	V	14.84	-	53.60	74.00	20.40
10359.00	30.79	PK	H	31.08	-	61.87	74.00	12.13
10359.00	19.24	AV	V	31.08	-	50.32	54.00	3.68
10359.00	29.90	PK	H	31.08	-	60.98	74.00	13.02
10359.00	19.08	AV	V	31.08	-	50.16	54.00	3.84

802.11a / 5220 ㎒

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	AFCL (㏈)	DCF (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
10440.00	29.75	PK	H	31.40	-	61.15	74.00	12.85
10440.00	18.85	AV	V	31.40	-	50.25	54.00	3.75
10440.00	30.42	PK	H	31.40	-	61.82	74.00	12.18
10440.00	18.93	AV	V	31.40	-	50.33	54.00	3.67

802.11a / 5240 ㎒

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	AFCL (㏈)	DCF (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
10480.00	30.90	PK	H	31.56	-	62.46	74.00	11.54
10480.00	19.06	AV	V	31.56	-	50.62	54.00	3.38
10480.00	30.28	PK	H	31.56	-	61.84	74.00	12.16
10480.00	19.32	AV	V	31.56	-	50.88	54.00	3.12

Note.

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) + DCF(Duty cycle Correction Factor)+Distance
5. DCF(Duty cycle Correction Factor) = 10log(1/Duty cycle)

802.11n_HT20 / 5180 ㎒

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
4809.26	35.20	PK	H	13.58	-	48.78	74.00	25.22
4883.33	36.49	PK	V	14.07	-	50.56	74.00	23.44
10360.00	30.91	PK	H	31.09	-	62.00	74.00	12.00
10360.00	19.12	AV	V	31.09	-	50.21	54.00	3.79
10360.00	29.57	PK	H	31.09	-	60.66	74.00	13.34
10360.00	19.45	AV	V	31.09	-	50.54	54.00	3.46

802.11n_HT20 / 5220 ㎒

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
10440.00	30.87	PK	H	31.40	-	62.27	74.00	11.73
10440.00	19.19	AV	V	31.40	-	50.59	54.00	3.41
10440.00	29.65	PK	H	31.40	-	61.05	74.00	12.95
10440.00	18.64	AV	V	31.40	-	50.04	54.00	3.96

802.11n_HT20 / 5240 ㎒

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
10480.00	29.25	PK	H	31.56	-	60.81	74.00	13.19
10480.00	18.93	AV	V	31.56	-	50.49	54.00	3.51
10480.00	30.54	PK	H	31.56	-	62.10	74.00	11.90
10480.00	19.37	AV	V	31.56	-	50.93	54.00	3.07

Note.

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) + DCF(Duty cycle Correction Factor)+Distance
5. DCF(Duty cycle Correction Factor) = 10log(1/Duty cycle)

802.11n_HT40 / 5190 ㎒

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
4892.06	36.54	PK	H	14.13	-	50.67	74.00	23.33
4909.34	35.20	PK	V	14.24	-	49.44	74.00	24.56
10380.00	29.95	PK	H	31.17	-	61.12	74.00	12.88
10380.00	18.81	AV	V	31.17	-	49.98	54.00	4.02
10380.00	30.09	PK	H	31.17	-	61.26	74.00	12.74
10380.00	18.88	AV	V	31.17	-	50.05	54.00	3.95

802.11n_HT40 / 5230 ㎒

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
10460.00	29.82	PK	H	31.48	-	61.30	74.00	12.70
10460.00	19.07	AV	V	31.48	-	50.55	54.00	3.45
10460.00	30.62	PK	H	31.48	-	62.10	74.00	11.90
10460.00	18.53	AV	V	31.48	-	50.01	54.00	3.99

Note.

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) + DCF(Duty cycle Correction Factor)+Distance
5. DCF(Duty cycle Correction Factor) = 10log(1/Duty cycle)

Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV30	101389	1 year	2015.04.30
Spectrum analyzer	Agilent	N9010A	MY51440103	1 year	2016.01.26
Power Meter	Anritsu	ML2495A	1438001	1 year	2015.09.24
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2015.10.03
Vector signal generator	R&S	SMBV100A	1407.6004K02	1 year	2015.07.24
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2015.04.30
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	Schwarzbeck	BBHA 9170	BBHA9170551	2 years	2015.09.04
Preamplifier	HP	8447F	2805A02570	1 year	2015.04.30
Preamplifier	HP	8449B	3008A00538	1 years	2015.07.23
Preamplifier	Schwarzbeck	BBV 9721	9721-003	1 years	2015.09.04
Attenuator	HP	8494B	2630A12857	1 year	2015.04.30
EMI Test Receiver	R & S	ESVS10	826008/014	1 year	2015.04.04
EMI Receiver/Signal Analyzer	Narda S.T.S / PMM	PMM 9010F	020WW31006	1 year	2015.04.04
LISN	R & S	ENV216	101137	1 year	2015.02.21
HIGH PASS FILTER	WAINWRIGHT INSTRUMENT	WHNX6.0/26.5G-6SS	1	1 year	2015.07.23
HIGH PASS FILTER	WAINWRIGHT INSTRUMENT	WHJS3000-10TT	1	1 year	2015.07.23
LOW PASS FILTER	WEINSCHEL	WLK1.0/18G-10TT	1	1 year	2015.07.23

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Desktop	DELL	OPTIPLEX990	95KYVBX
Monitor	SAMSUNG	LS23C340	ZXPCHTMFB01032M
Adapter	11ssan Elecom(shen yang) Co., Ltd.	A2514_DPN	CN07BN4400591 BSK28F6NF841
Mouse	Logitech	M-U0026	1248HS021ZRS
Keyboard	Logitech	Y-S0002	-

Appendix B. Test setup photo

Radiated Emission (30㎒~1㎓)

Radiated Emission (Above 1㎓)