



TEST REPORT

Part 15 Subpart C 15.247

Equipment under test TWSN

Model name SC-300

FCC ID PBUSC-300

Applicant Jcast Network Korea, Inc.

Manufacturer Jcast Network Korea, Inc.

Date of test(s) 2012.08.13 ~ 2012.08.20

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Issued to

Jcast Network Korea, Inc.

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Revision history

Revision	Date of issue	Test report No.	Description
-	2012.08.17	KES-RF-120061	Initial



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1.0 General product description

Equipment under test	uRSE
Model name	SC-300
Serial number	N/A
Frequency Range	2 405 MHz ~ 2 480 MHz
Modulation technique	DSSS
Number of channels	16
Antenna type & gain	Omni antenna// 5.0 dBi
Power source	AC 120 V

1.1 Test frequency

	Low channel	Middle channel	High channel
Frequency (MHz)	2 405	2 440	2 480

1.2 Model differences

N/A

1.3 Device modifications

N/A

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1.4 Test facility

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The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

1.5 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

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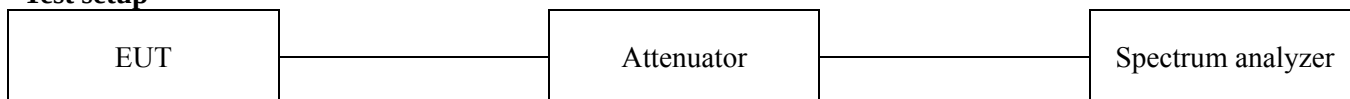
2.0 Summary of tests

Section	Parameter	Status
15.247(a)(2) ANSI C63.4-2003 KDB558074 D01 DTS Meas Guidance v01	6 dB bandwidth	C
15.247(b)(3) ANSI C63.4-2003 KDB558074 D01 DTS Meas Guidance v01	Output power	C
15.247(e) ANSI C63.4-2003 KDB558074 D01 DTS Meas Guidance v01	Power spectral density	C
15.205(a), 15.209(a), 15.247(d) ANSI C63.4-2003	Radiated spurious emission and conducted spurious emission	C
15.207	AC conducted emissions	C
Note: C=Complies NC=Not complies NT=Not tested NA=Not applicable		

2.1 Test data

2.1.1 6 dB bandwidth

Test setup



Test procedure

The testing follows KDB publication No. 558074 D01 DTS measurement.

1. Set resolution bandwidth (RBW) = 1~5 % of the emission bandwidth (EBW).
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1~5 %.

Limit

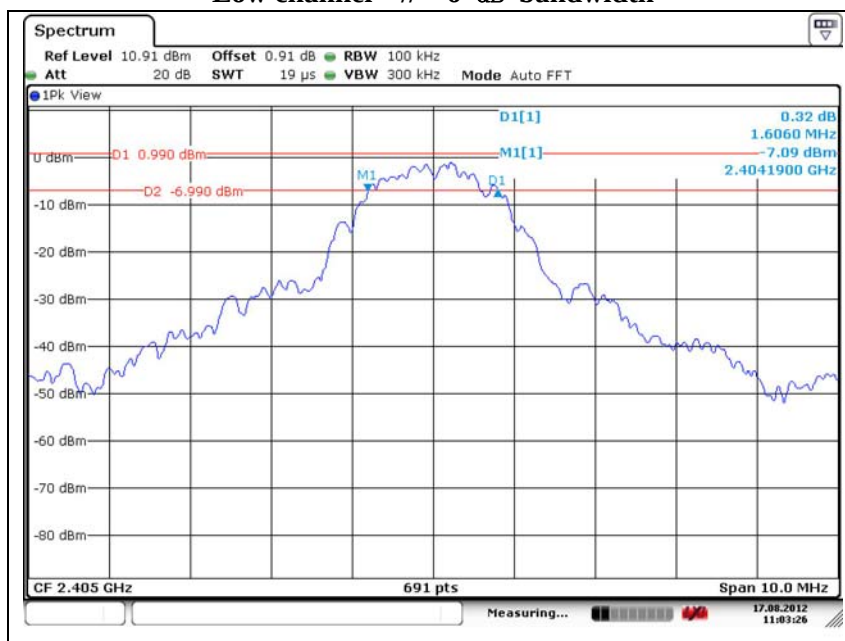
According to §15.247(a)(2), systems using digital modulation techniques may operate 902 ~ 928 MHz, 2 400 ~ 2 483.5 MHz, and 5 725 ~ 5 850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.



Test results

Operation mode	Frequency(MHz)	6 dB bandwidth(MHz)	Limit(MHz)
DSSS	2 405	1.606	0.5
	2 440	1.592	
	2 480	1.577	

Low channel // 6 dB bandwidth

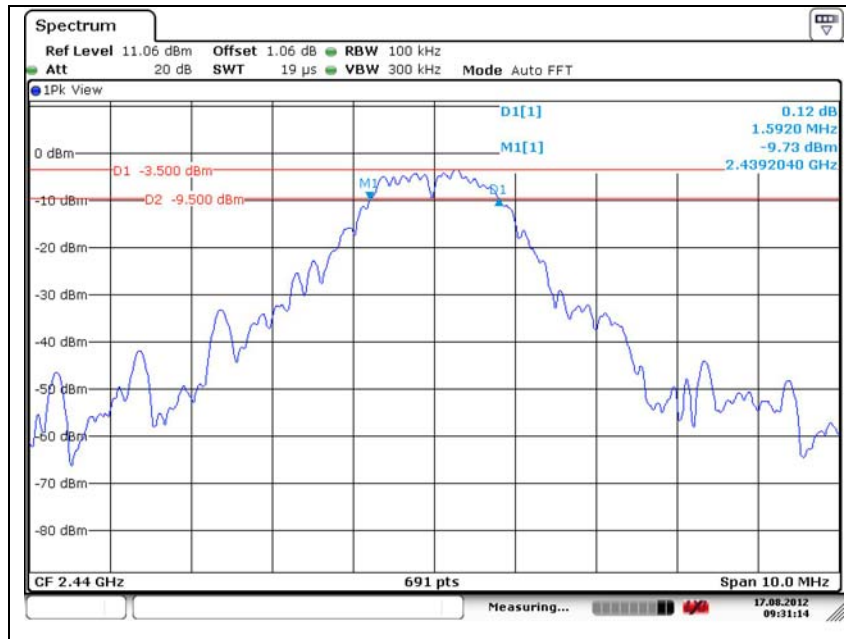




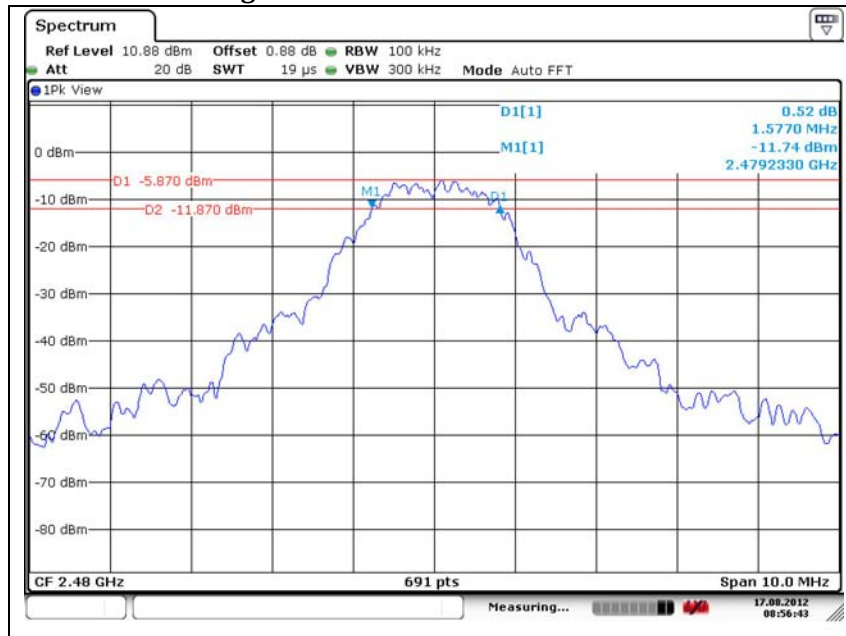
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Middle channel // 6 dB bandwidth

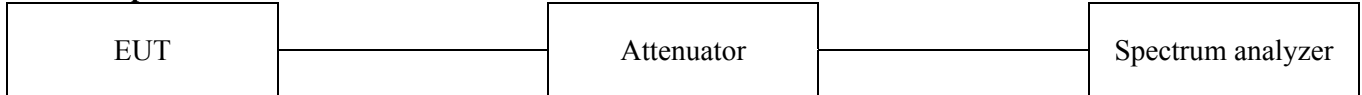


High channel // 6 dB bandwidth



2.1.3 Output power

Test setup



Test procedure

The testing follows KDB publication No. 558074 D01 DTS measurement.

Measurement procedure PK1

1. This procedure requires availability of a spectrum analyzer resolution bandwidth that is $\geq$ EBW.
2. Set the RBW $\geq$ EBW.
3. Set the VBW $\geq 3 \times$ RBW.
4. Set span = zero.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use peak marker function to determine the peak amplitude level within the fundamental emission.

Limit

According to §15.247(b)(3), For systems using digital modulation in the 902~928 MHz, 2 400~2 483.5 MHz, and 5 725~5 850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted out-put power. Maximum Conducted Out-put Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4), The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



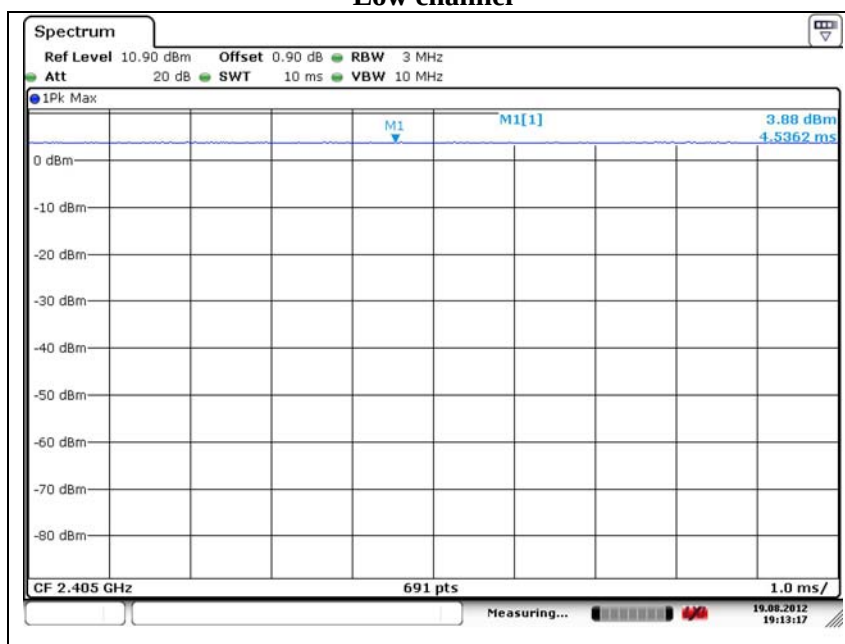
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Test results

Operation mode	Frequency(MHz)	Output power(dBm)	Limit(dBm)
DSSS	2 405	3.88	30
	2 440	1.86	
	2 480	-0.59	

Low channel

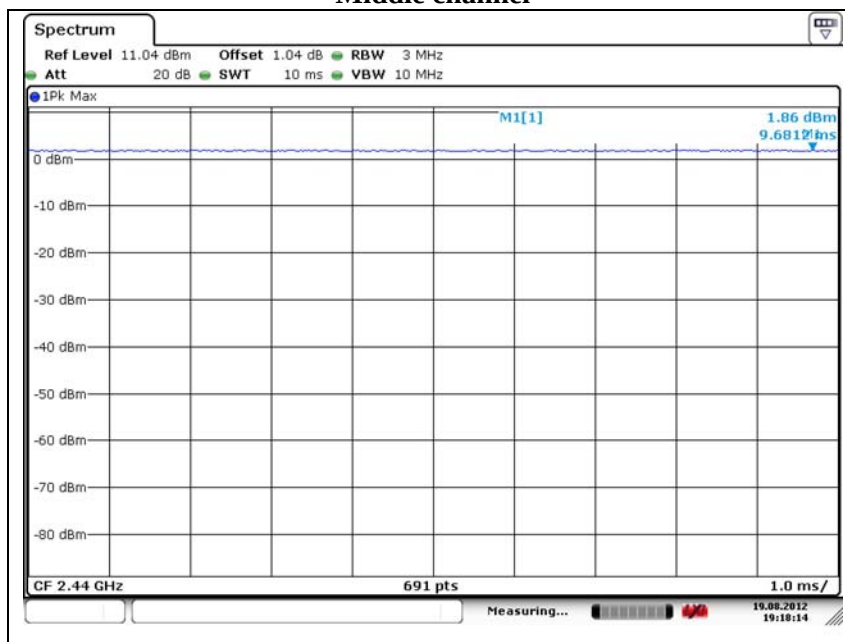




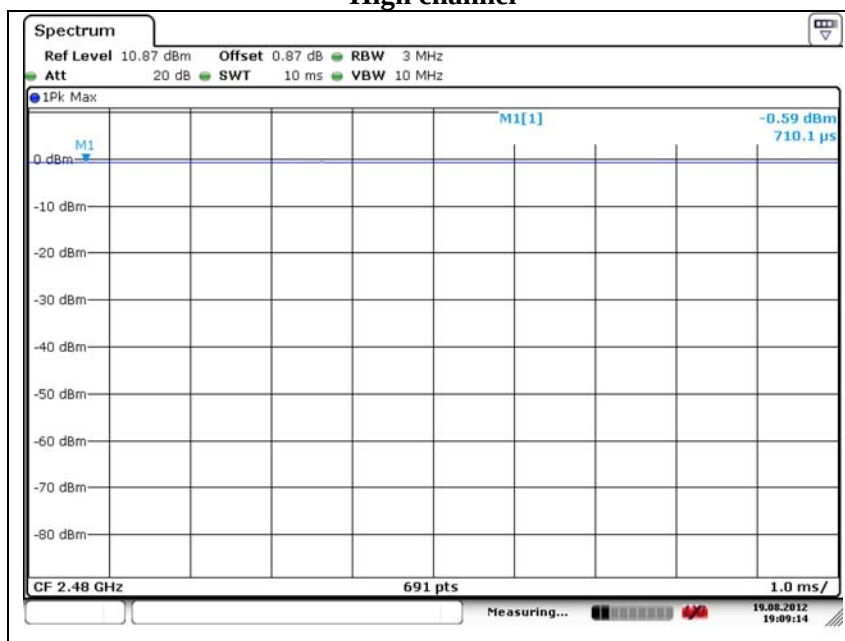
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Middle channel

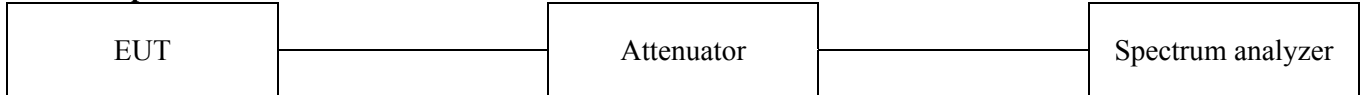


High channel



2.1.4 Power spectral density

Test setup



Test procedure

The testing follows KDB publication No. 558074 D01 DTS measurement.

Measurement procedure PKPSD

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 100 kHz.
3. Set the VBW $\geq$ 300 kHz.
4. Set the span to 5-30 % greater than the EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
10. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where $BWCF = 10\log(3 \text{ kHz}/100 \text{ kHz}) = -15.2 \text{ dB}$.
11. The resulting peak PSD level must be $\leq 8 \text{ dBm}$.

Limit

According to §15.247(e), 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.



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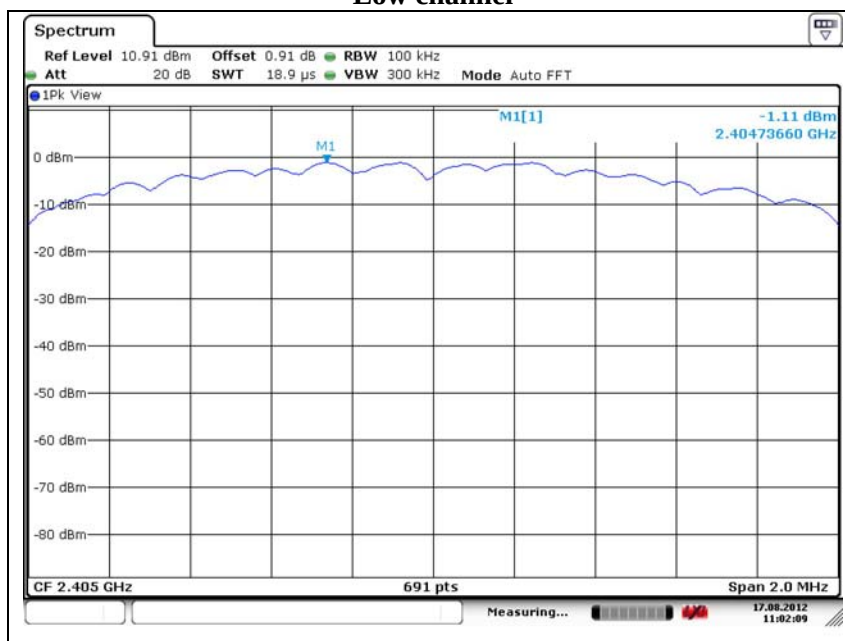
Test results

Operation mode	Frequency(MHz)	Measured PSD(dBm)	BWCF(dB)	Corrected PSD(dBm)	Limit(dBm)
802.11b	2 412	-5.19	-15.2	-20.39	8
	2 442	-4.50		-19.70	
	2 462	-6.17		-21.37	

Note;

Corrected PSD(dBm) = Measure PSD(dBm) + BWCF(dB)

Low channel

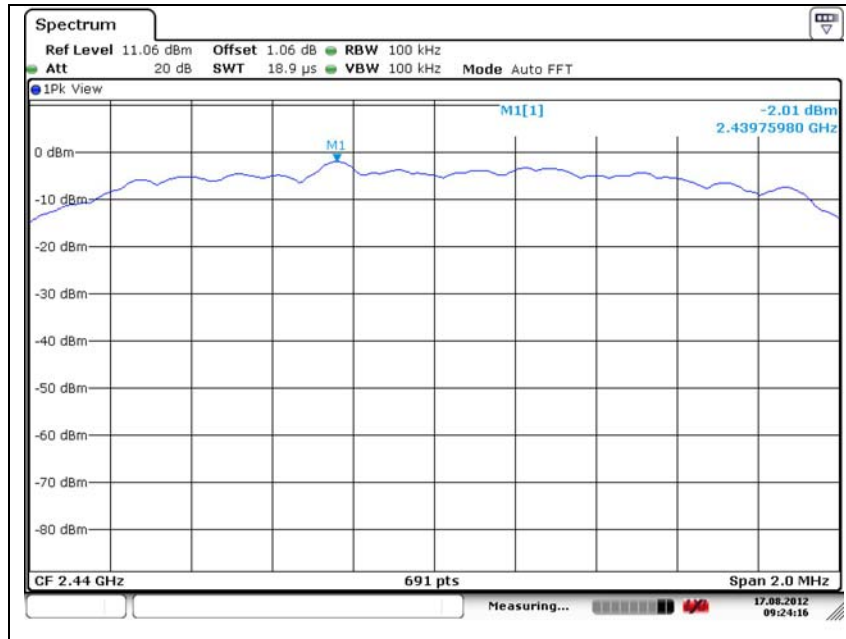




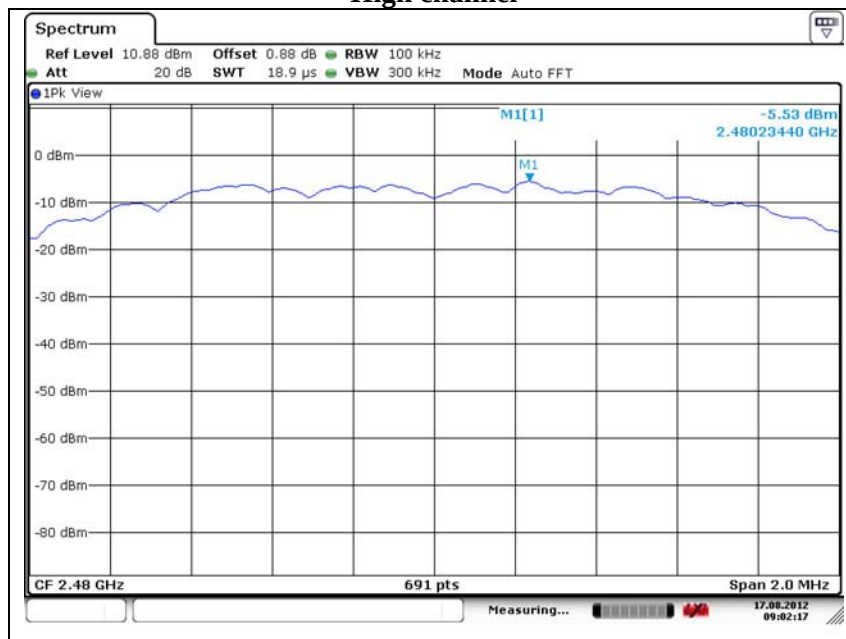
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Middle channel



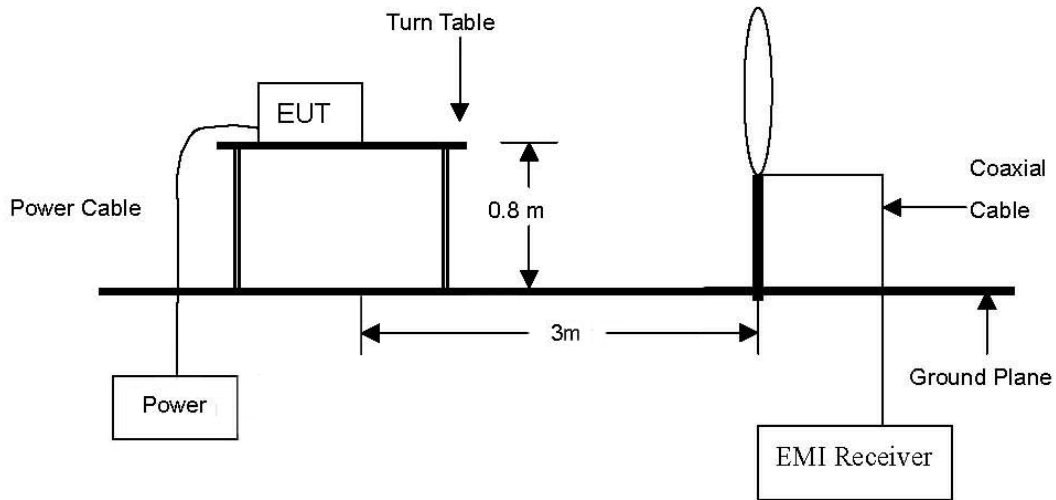
High channel



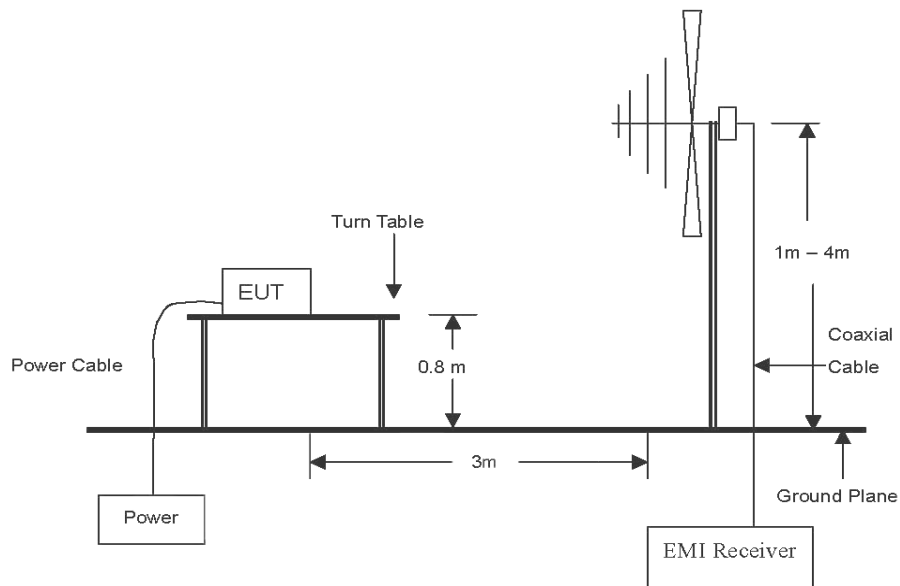
2.1.5 Radiated spurious emissions and conducted spurious emissions

Test setup for radiated spurious emissions

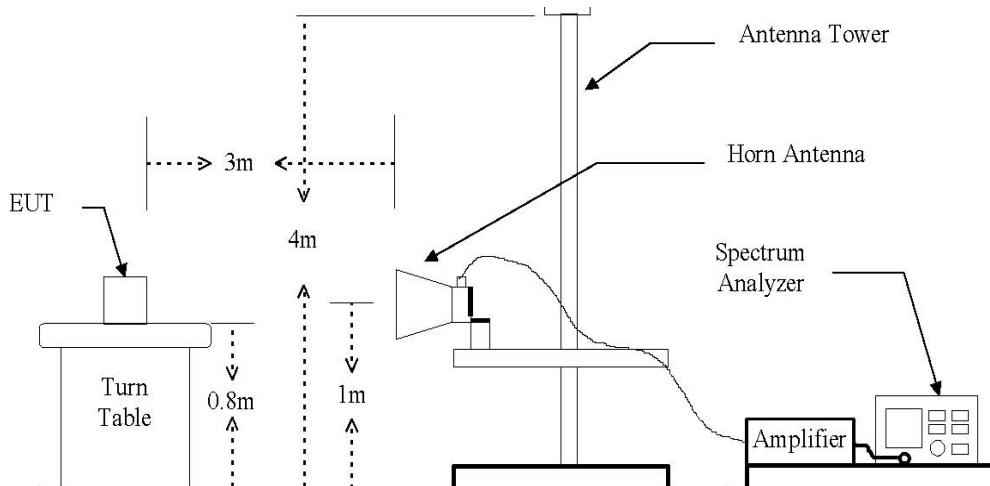
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



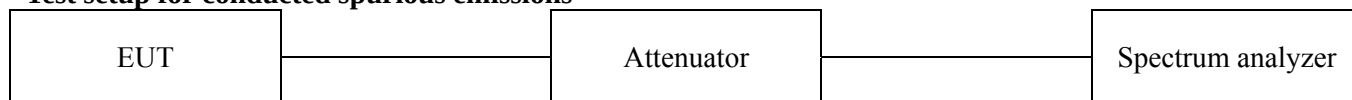
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 24 GHz emissions.



Test setup for conducted spurious emissions



Test procedures for radiated spurious emissions

Radiated emissions from the EUT were measured according to the dictates in section 5.4 of KDB 558074 [9 kHz to 30 MHz]

The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Quasi-peak function and specified bandwidth with maximum hold mode.

The spectrum analyzer is set to:

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

[30 MHz to 1 GHz and 1 GHz to 24 GHz]

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.

The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

The spectrum analyzer is set to:

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

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.

Test procedure for conducted spurious emissions

Per the guidance of KDB 558074, section 5.4.1.1, the reference level for out of band emissions is established from the plots of this section since the band edge emissions are measured with a RBW of 100 kHz. This reference level is then used as the limit in subsequent plots for out of band spurious emissions shown in page 48 of the test report. The limit for out of band spurious emission at the band edge is 20dB below the fundamental emission level measured in a 100 kHz bandwidth.

Limit for radiated spurious emissions

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 (MHz)	Distance (Meters)	Radiated ($\mu V/m$)
0.009 ~ 0.490	300	2400 / F(kHz)
0.490 ~ 1.705	30	24000 / F(kHz)
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 MHz, 76 ~ 88 MHz, 174 ~ 216 MHz or 470 ~ 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

Limit for conducted spurious emission

According to 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 section 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))

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Test results (Below 30 MHz) – Worst case configuration: Low Channel

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

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	F _d (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Below 30	Not detected							

※ Remark

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

Where:

- F_d = Distance factor in dB
D_m = Measurement distance in meters
D_s = Specification distance in meters

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Test results (Below 1 000 MHz) – Worst case configuration: Low Channel

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

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
64.0	23.24	V	12.48	1.01	36.73	40.00	3.27
76.1	24.16	H	10.25	1.10	35.51	40.00	4.49
107.6	27.08	H	9.63	1.27	37.98	43.50	5.52
119.7	26.99	H	11.19	1.29	39.47	43.50	4.03
119.7	26.50	V	11.19	1.29	38.98	43.50	4.52
131.9	24.72	H	12.09	1.31	38.12	43.50	5.38
131.9	24.65	V	12.09	1.31	38.05	43.50	5.45
144.0	24.84	H	12.81	1.40	39.05	43.50	4.45
144.0	24.17	V	12.81	1.40	38.38	43.50	5.12
156.1	20.24	H	13.19	1.58	35.01	43.50	8.49
197.3	24.49	V	10.17	1.75	36.41	43.50	7.09
267.7	23.68	H	12.27	1.93	37.88	46.00	8.12
534.4	16.50	H	18.42	2.66	37.58	46.00	8.42
534.4	13.01	V	18.42	2.66	34.09	46.00	11.91
667.8	14.29	H	20.48	3.08	37.85	46.00	8.15
667.8	11.57	V	20.48	3.08	35.13	46.00	10.87
886.0	11.00	H	23.13	3.45	37.58	46.00	8.42
886.0	10.49	V	23.13	3.45	37.07	46.00	8.93

※ Remark

1. All spurious emission at channels are almost the same below 1 GHz, so that Low channel was 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.

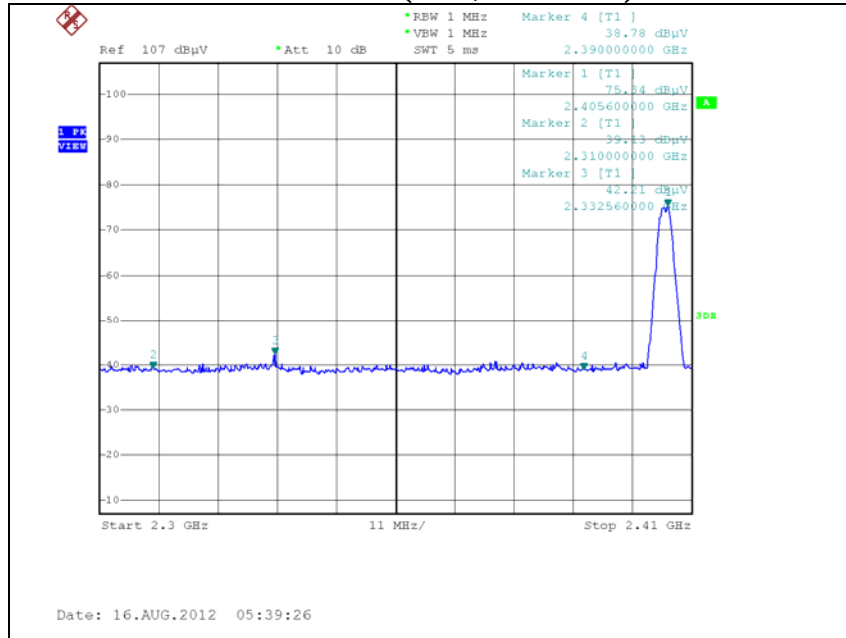


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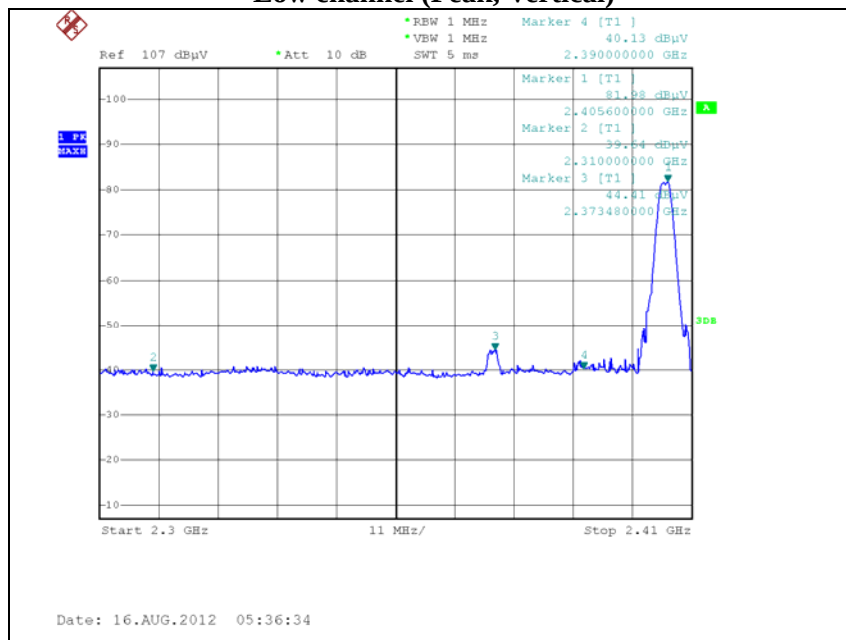
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Test results (Above 1 000 MHz)

Low channel (Peak, Horizontal)



Low channel (Peak, Vertical)

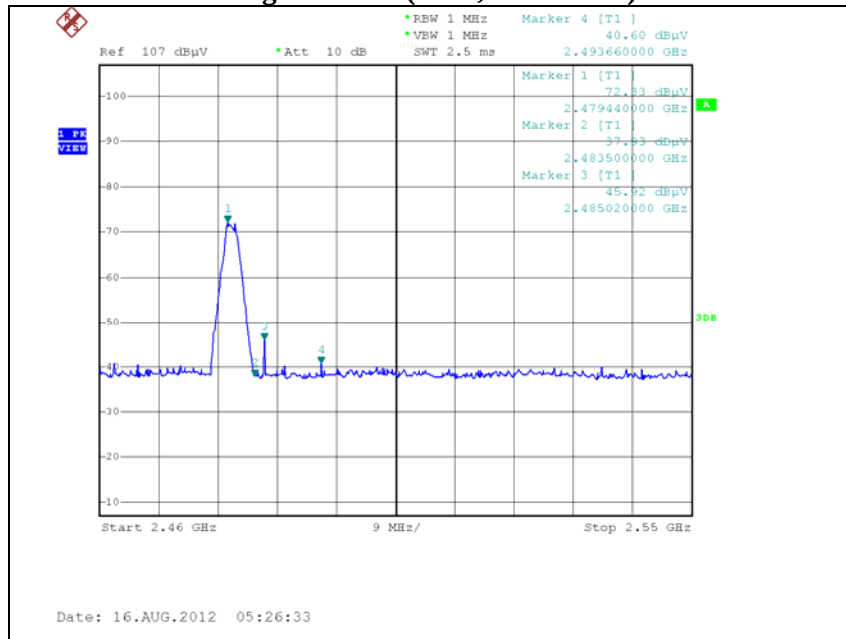




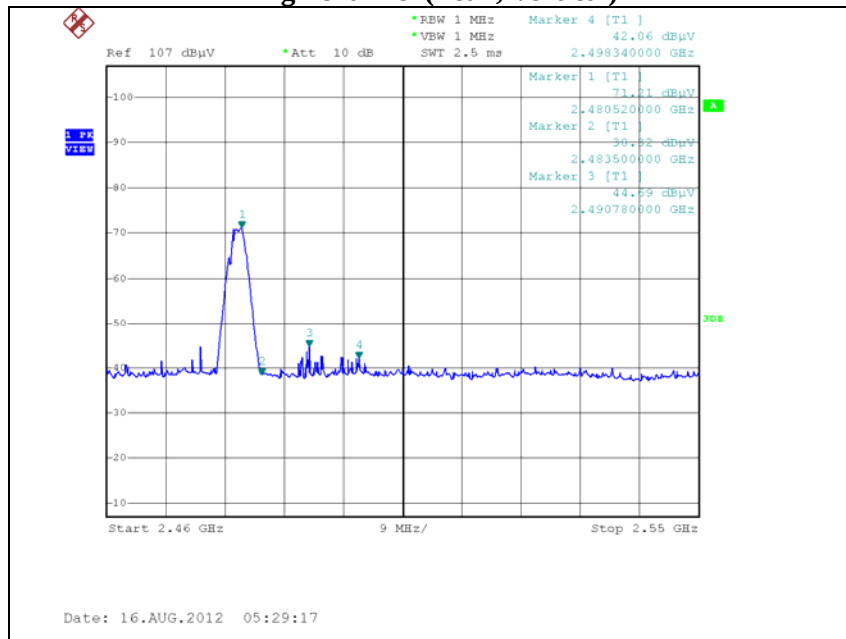
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High channel (Peak, Horizontal)



High channel (Peak, Vertical)



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Low channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 390.0	38.73	Peak	H	28.31	-38.88	28.16	74.00	45.84
2 390.0	40.13	Peak	V	28.31	-38.88	29.56	74.00	44.44

Middle channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000	Not detected							

High channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 483.5	37.93	Peak	H	28.50	-38.73	27.70	74.00	46.30
2 483.5	38.32	Peak	V	28.50	-38.73	28.09	74.00	45.91

※ Remark

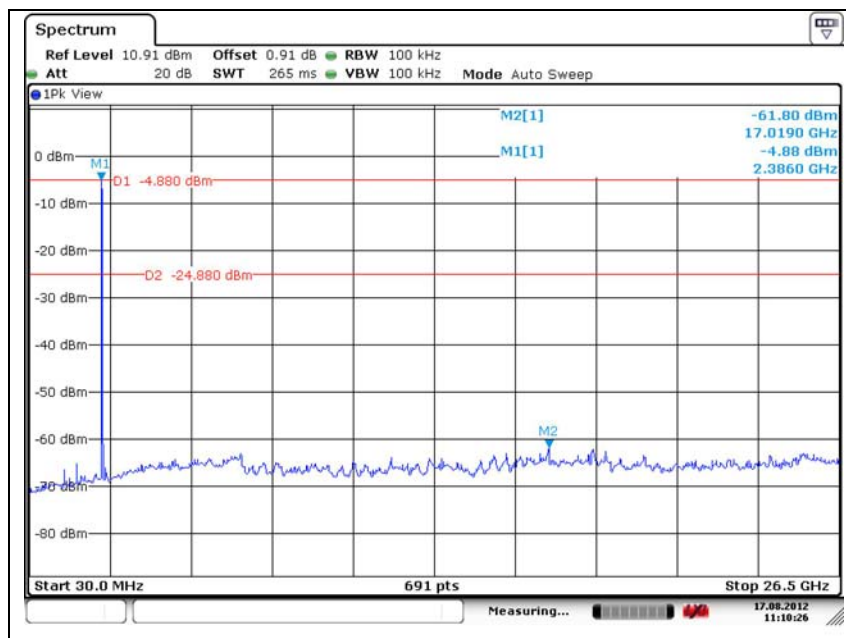
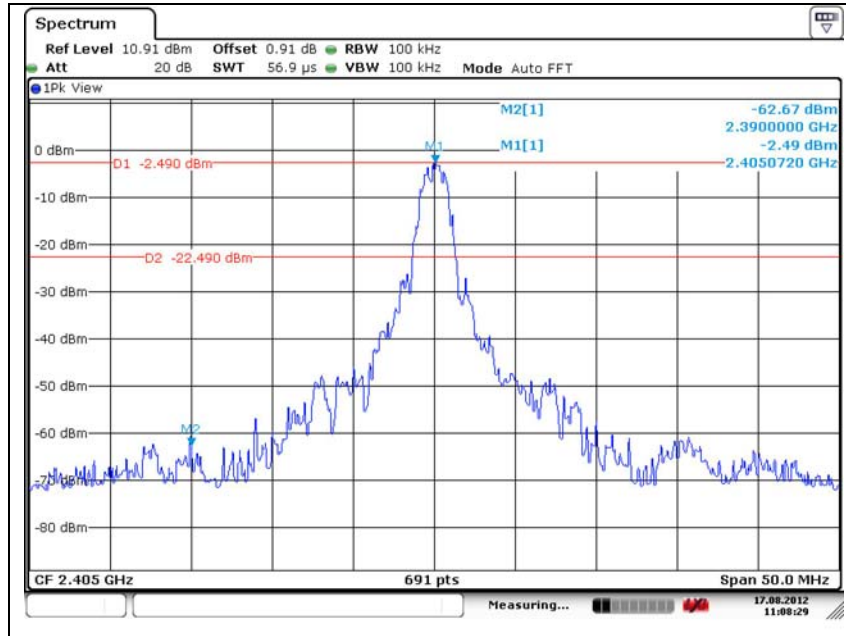
1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.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



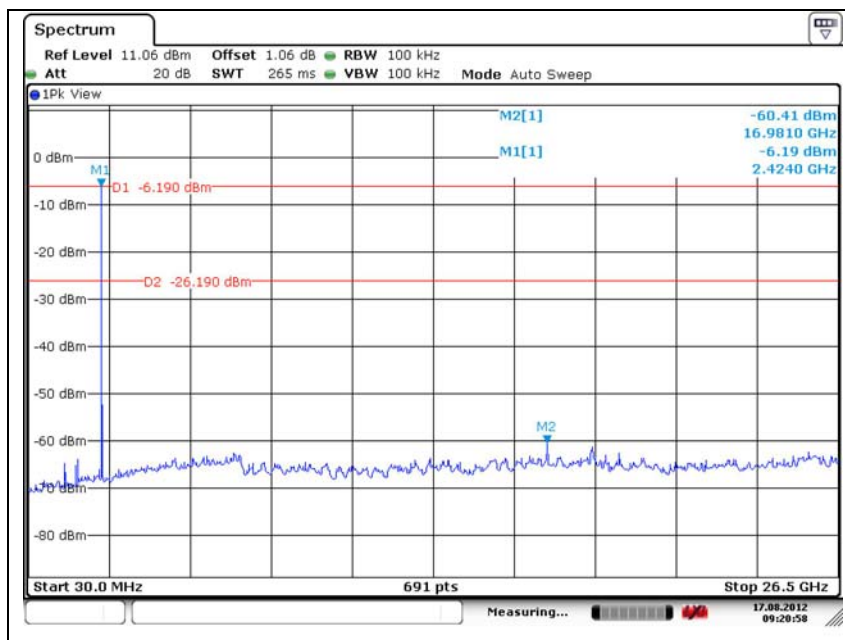
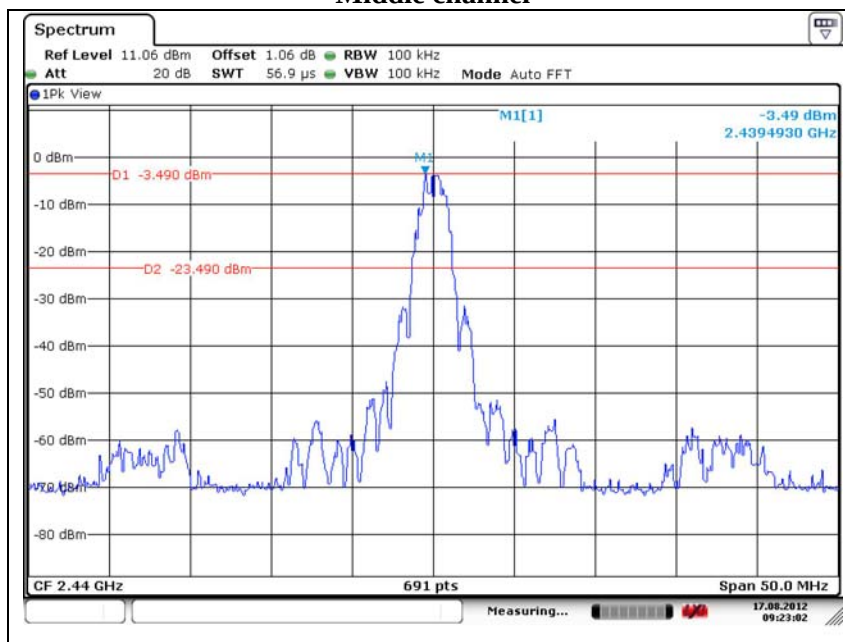
KES Co., Ltd.

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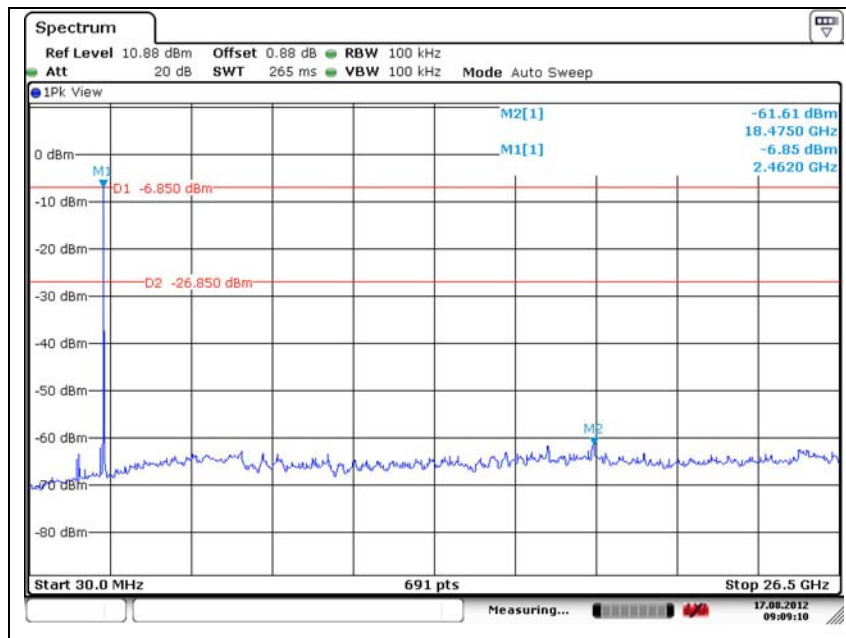
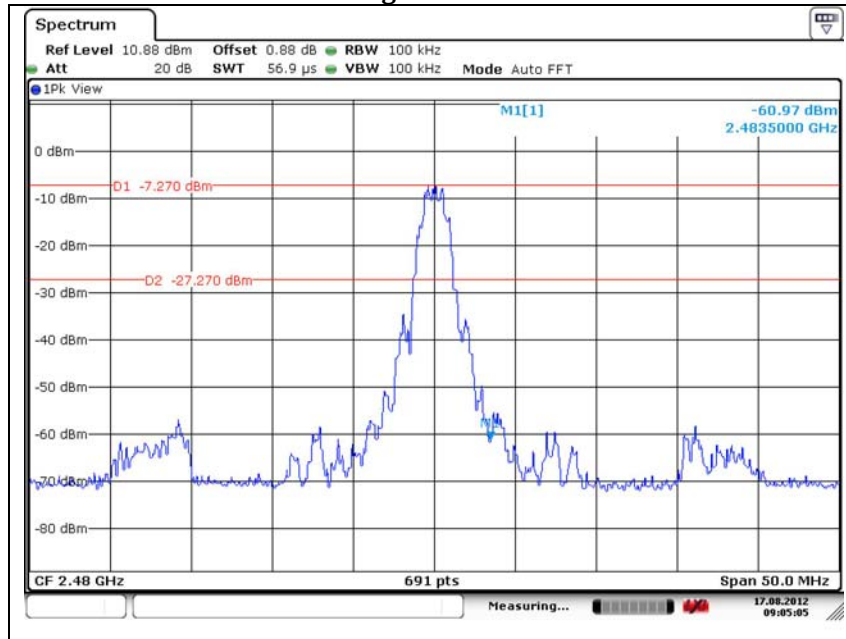
Low channel



Middle channel



High channel





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2.1.6 AC conducted emissions

Frequency range of measurement

150 kHz to 30 MHz

Instrument settings

IF Band Width: 9 kHz

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

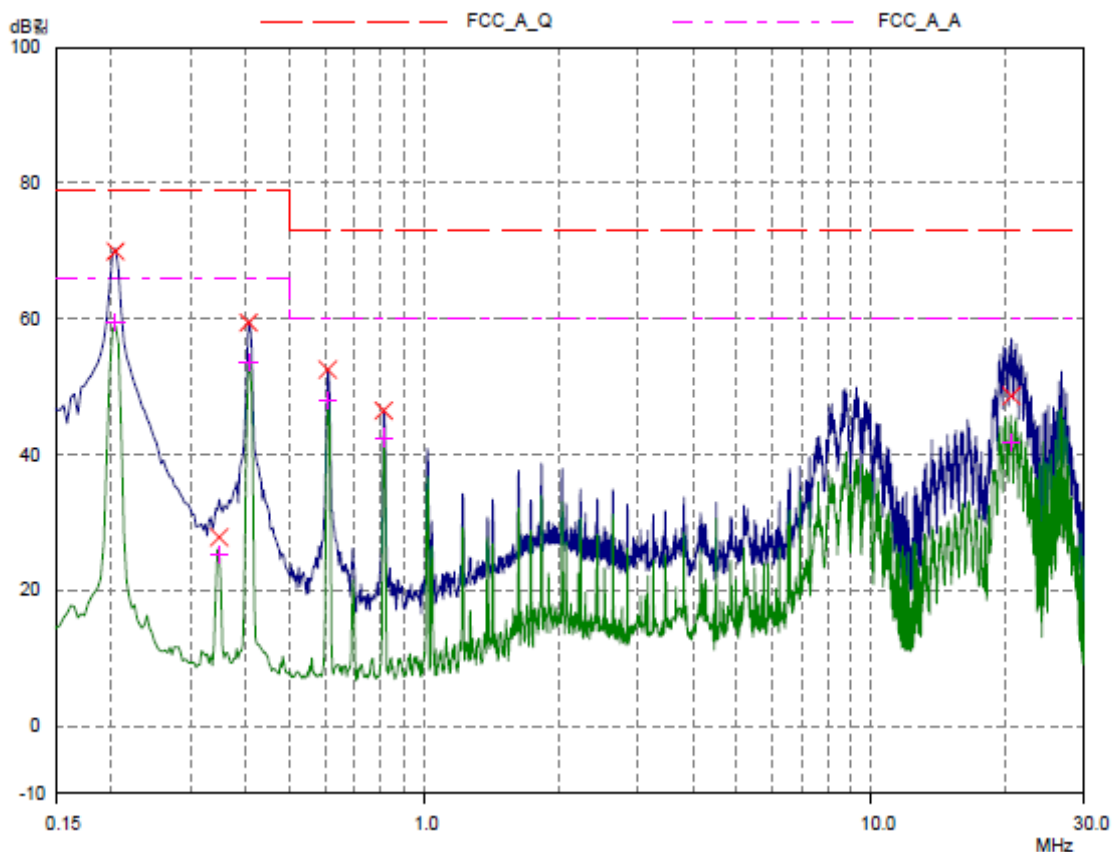
According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the 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 (MHz)	Conducted limit (dBμV/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

※ Remark

Decreases with the logarithm of the frequency.

Test results



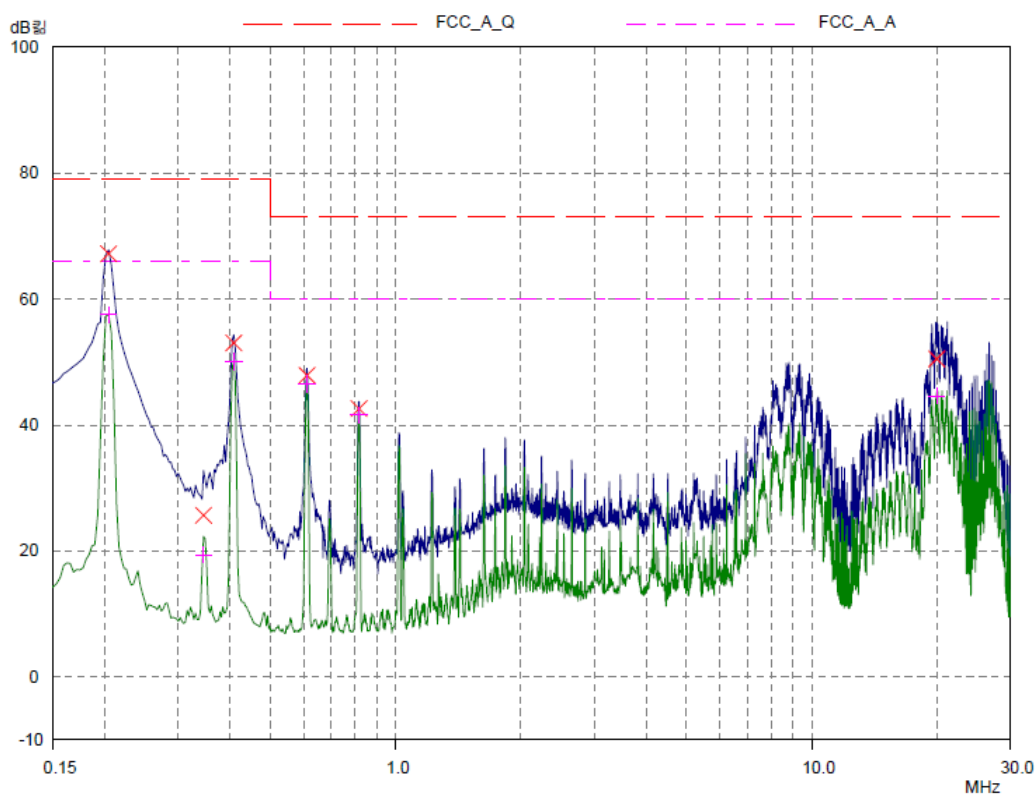
Final Measurement Results

Frequency MHz	QP Level dBm	QP Limit dBm	QP Delta dB
0.204	69.95	79.00	9.05
0.348	27.77	79.00	51.23
0.405	59.45	79.00	19.55
0.609	52.53	73.00	20.47
0.813	46.46	73.00	26.54
20.658	48.66	73.00	24.34

Frequency MHz	AV Level dBm	AV Limit dBm	AV Delta dB
0.204	59.42	66.00	6.58
0.348	25.30	66.00	40.70
0.405	53.57	66.00	12.43
0.609	47.99	60.00	12.01
0.813	42.49	60.00	17.51
20.658	41.74	60.00	18.26

Note;

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



Final Measurement Results

Frequency MHz	QP Level dBm	QP Limit dBm	QP Delta dB
0.204	67.20	79.00	11.80
0.345	25.66	79.00	53.34
0.408	53.03	79.00	25.97
0.612	47.89	73.00	25.11
0.816	42.60	73.00	30.40
19.983	50.49	73.00	22.51

Frequency MHz	AV Level dBm	AV Limit dBm	AV Delta dB
0.204	57.52	66.00	8.48
0.345	19.40	66.00	46.60
0.408	50.05	66.00	15.95
0.612	46.49	60.00	13.51
0.816	41.56	60.00	18.44
19.983	44.60	60.00	15.40

Note;

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

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Appendix A. Test equipment used for test

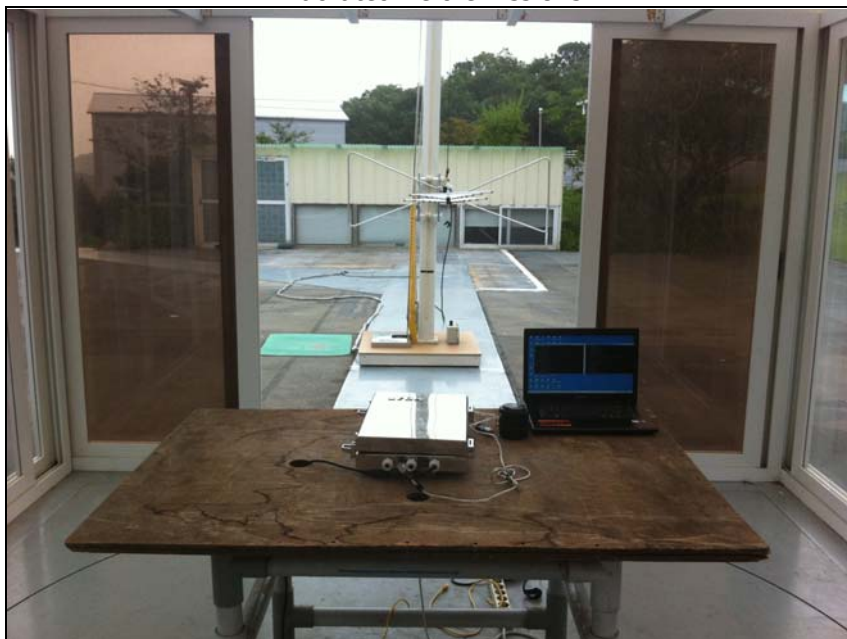
Equipment	Manufacturer	Model	Calibration due.
Spectrum Analyzer	R&S	FSV30	2013.01.10
Spectrum Analyzer	R&S	FSP	2013.05.04
Vector Signal Generator	R&S	SMBV2100A	2013.01.10
Signal Generator	HP	83630B	2013.06.06
Pulse/Function Generator	HP	8116A	2013.07.06
Loop Antenna	R&S	HFH2-Z2.335.4711.52	2013.03.10
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	2013.10.25
Horn Antenna	A.H. System	SAS-571	2013.03.22
High Pass Filter	Wainwright Instrument	WHJS3000-10TT	2013.01.10
Preamplifier	HP	8449B	2013.08.02
EMC Analyzer	Agilent	E7405A	2013.08.16
EMI TEST Receiver	R & S	ESHS10	2013.05.04
LISN	R & S	ENV216	2013.02.27
LISN	EMCO	3810/2	2013.04.18

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook	Samsung electronics	NT-R410Y	Z9YJ93CS300631H

Appendix B. Test setup photos

Radiated field emissions



AC conducted emission

