TEST REPORT

Part 15 Subpart C 15.247

Equipment under test I-pad Keyboard Case

Model name CLNK1000

FCC ID PZYCLNK1000

Applicant Core Logic, Inc.

Manufacturer Core Logic, Inc.

Date of test(s) 2014.05.08 ~ 2014.05.20

Date of issue 2014.05.20

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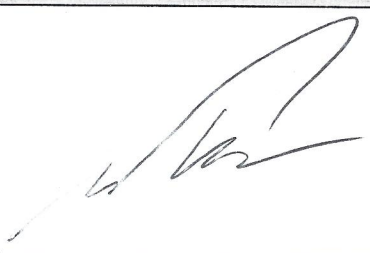	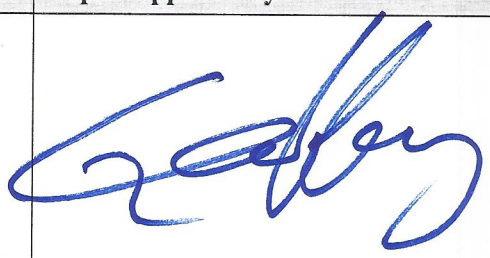
Kwang-Yeol Choo Test engineer	Jeff Do Technical manager

Revision history

Revision	Date of issue	Test report No.	Description
-	2014.05.20	KES-RF-14T0026	Initial

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1. General information

1.1. EUT description

Equipment under test	I-pad Keyboard Case
Model name	CLNK1000
Serial number	N/A
Frequency range	2402 ㎒ ~ 2480 ㎒
Modulation technique	GFSK
Number of channels	2402 ㎒ ~ 2480 ㎒: 40ch
Antenna type & gain	PCB antenna // 2 dBi
Power source	DC 3.7 V(Battery)

1.2. Test frequency

	Low channel	**Middle channel**	**High channel**
Frequency (㎒)	2 402	2 442	2 480

1.3. Information about derivative model

N/A

1.4. Device modifications

N/A

1.5. 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.

1.6. 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
15.205 15.209	Radiated spurious emission	Pass
15.247(d)	Conducted spurious emission and band edge	Pass
15.247(a)(2)	6 dB bandwidth	Pass
15.247(b)(3)	Peak output power	Pass
15.247(e)	Power spectral density	Pass
15.207	AC conducted emissions	Pass

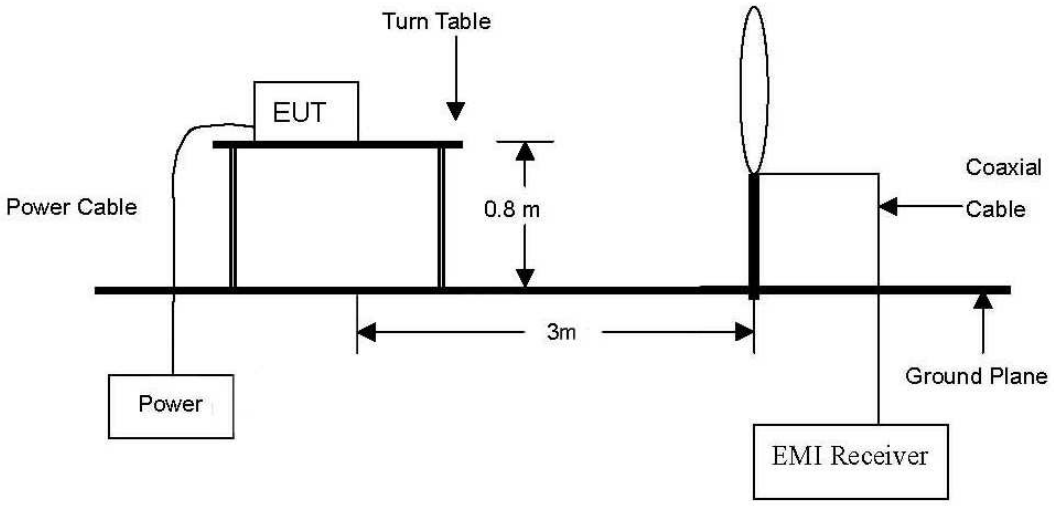
Test procedures;
The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 ㎑ to 40 ㎓ (ANSI C63.4-2003/2009), the guidance provided in KDB 558074_v03r01 were used in the measurement of the EUT.

3. Test results

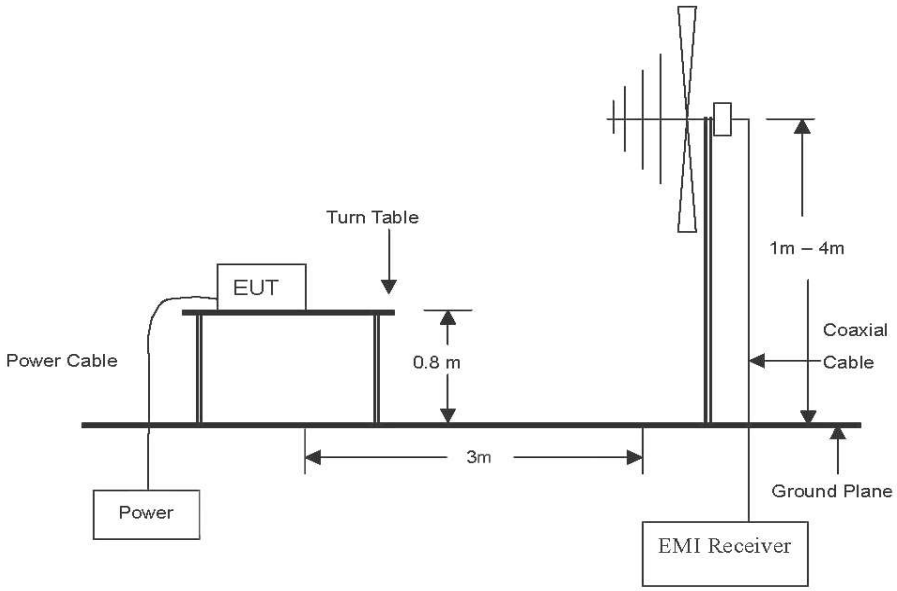
3.1 Radiated spurious emissions

Test setup

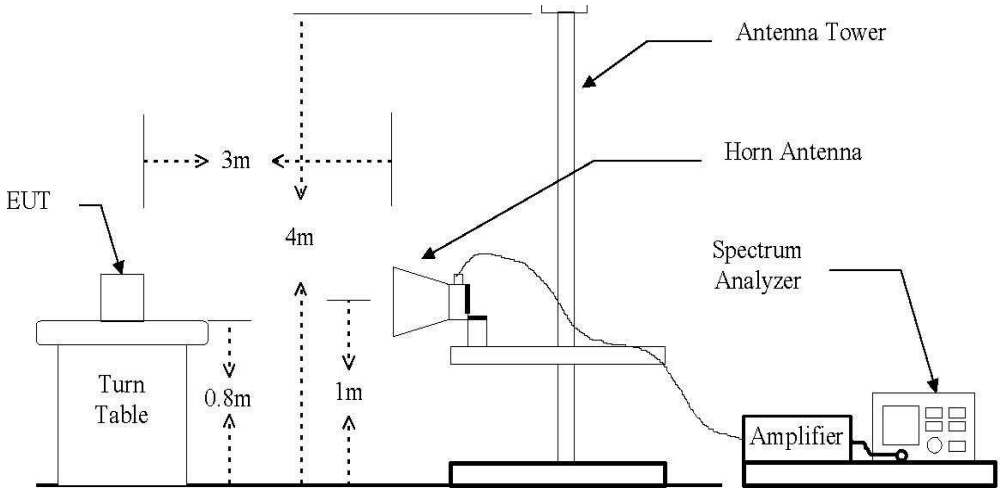
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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 24 ㎓ emissions.



Test procedure

Radiated emissions from the EUT were measured according to the dictates in section 12.0 of KDB 558074_v03r01 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 ㎓.

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.

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 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 (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 ㏈.

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Pol.	Ant. factor (㏈/m)	Cable loss (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
147.659	8.60	V	12.96	2.49	24.05	43.50	19.45
158.176	7.30	H	13.28	2.61	23.19	43.50	20.31
340.761	8.00	V	14.29	4.33	26.62	46.00	19.38
360.374	7.80	V	14.72	4.51	27.03	46.00	18.97
377.030	8.10	H	15.08	4.67	27.85	46.00	18.15
444.281	7.90	H	16.54	5.20	29.64	46.00	16.36
485.852	7.60	V	17.44	5.50	30.54	46.00	15.46

Note.

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

Test results (Above 1 000 ㎒)

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

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)
1 196.49	57.12	PK	V	-8.95	48.17	74.00	25.83
1 200.40	58.19	PK	H	-8.92	49.27	74.00	24.73
1 498.45	55.99	PK	V	-7.09	48.90	74.00	25.10
1 498.74	55.18	PK	H	-7.09	48.09	74.00	25.91
2 389.43	55.90	PK	V	-3.24	52.66	74.00	21.34
2 389.95	50.51	PK	H	-3.24	47.27	74.00	26.73
2 490.11	52.49	PK	V	-3.02	49.47	74.00	24.53
2 497.27	47.46	PK	H	-3.00	44.46	74.00	29.54

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)
1 196.86	57.33	PK	V	-8.94	48.39	74.00	25.61
1 200.60	58.32	PK	H	-8.92	49.40	74.00	24.60
1 498.26	55.61	PK	V	-7.09	48.52	74.00	25.48
1 498.91	55.59	PK	H	-7.09	48.50	74.00	25.50
2 490.95	52.33	PK	V	-3.01	49.32	74.00	24.68
2 497.74	47.36	PK	H	-3.00	44.36	74.00	29.64

High channel

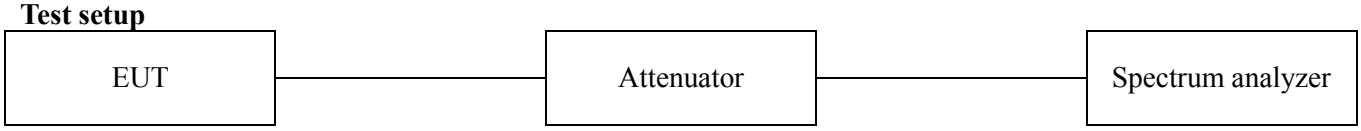
Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1 196.78	57.08	PK	V	-8.95	48.13	74.00	25.87
1 200.21	58.55	PK	H	-8.92	49.63	74.00	24.37
1 498.50	55.13	PK	V	-7.09	48.04	74.00	25.96
1 498.54	55.69	PK	H	-7.09	48.60	74.00	25.40
2 489.77	47.35	PK	H	-3.02	44.33	74.00	29.67
2 489.95	52.03	PK	V	-3.02	49.01	74.00	24.99
2 490.69	52.23	PK	V	-3.01	49.22	74.00	24.78
2 497.44	47.08	PK	H	-3.00	44.08	74.00	29.92

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)
5. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

3.2 Conducted spurious emissions & band edge

Test setup



Test procedure

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

Per the guidance of KDB 558074_v03r01, section 11.1&11.2,

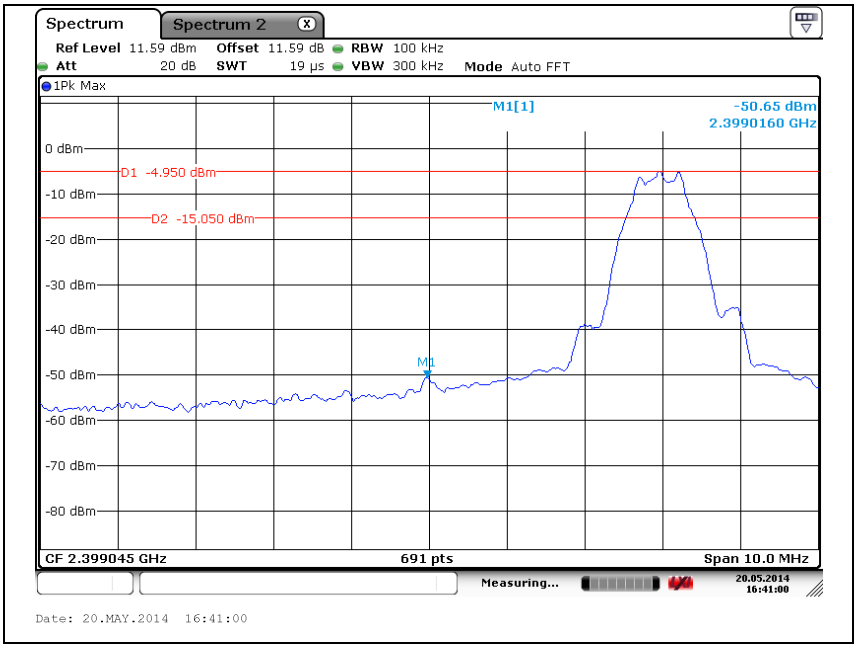
1. Use the following spectrum analyzer setting
   Center frequency: Low, Middle and high channel.
   RBW = 100 ㎑
   VBW = 300 ㎑ (≥3x RBW)
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excl uding restricted frequency bands) are attenuated by at least the minimum requirements specified in 1 1.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

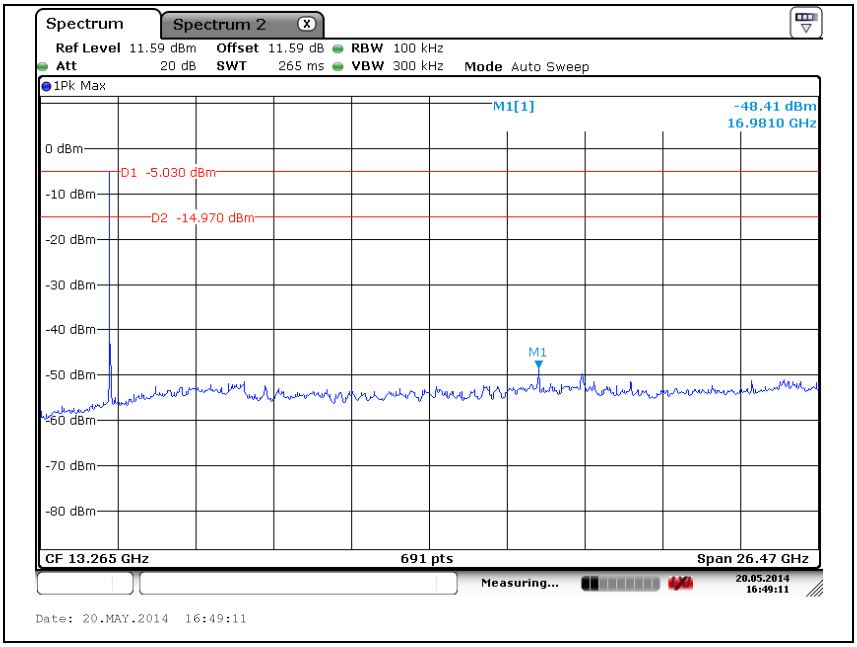
Limit

According to 15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. 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))

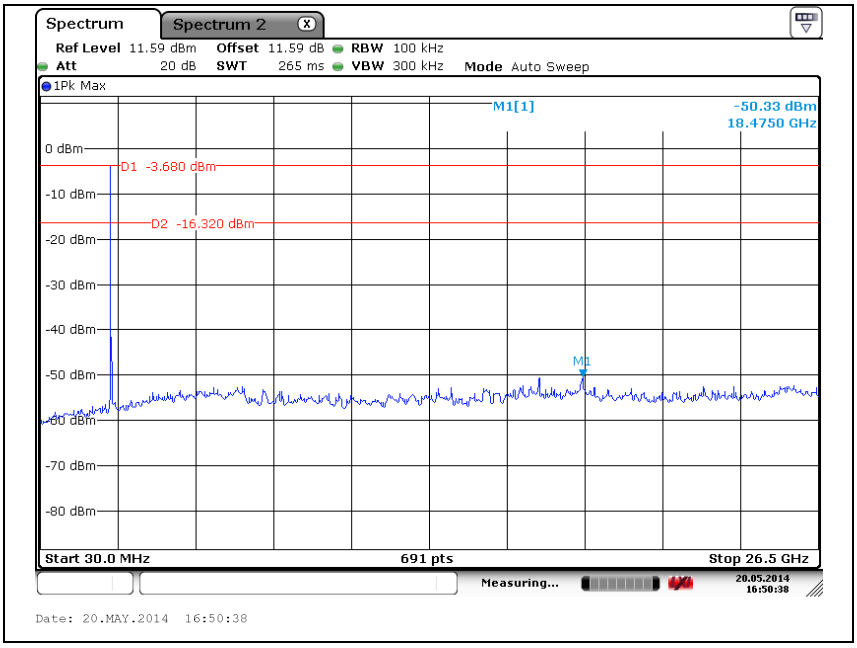
Test results

Low channel



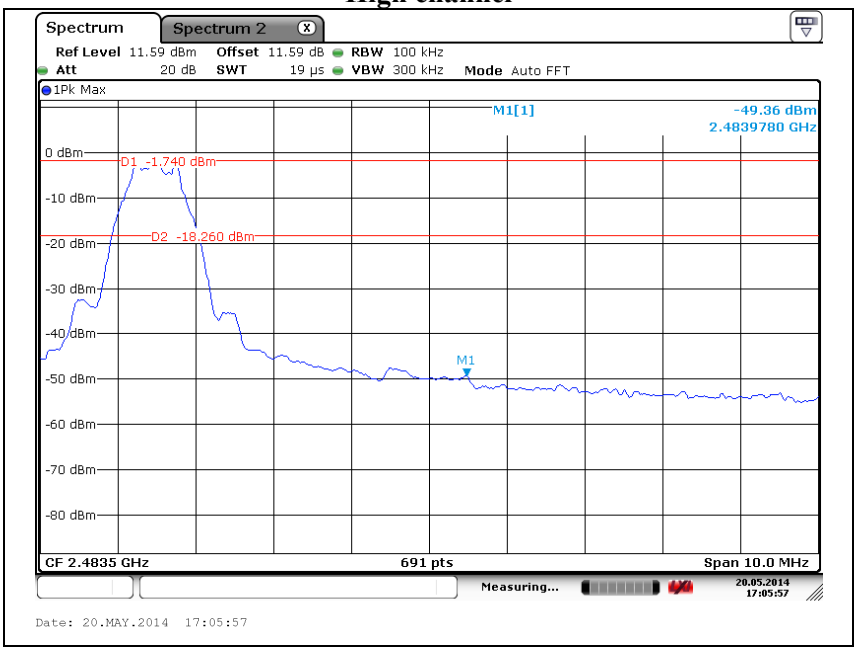


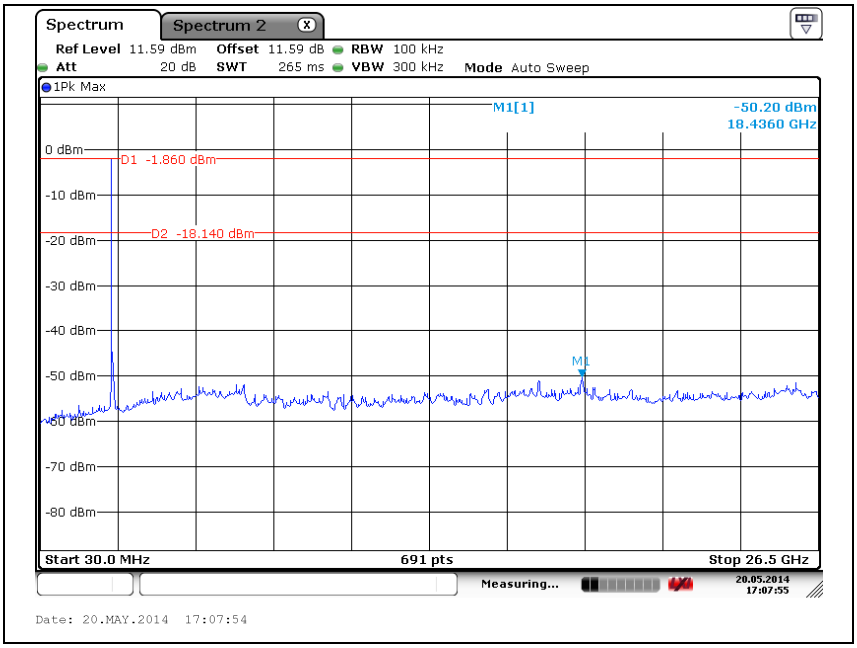
Middle channel



N/A

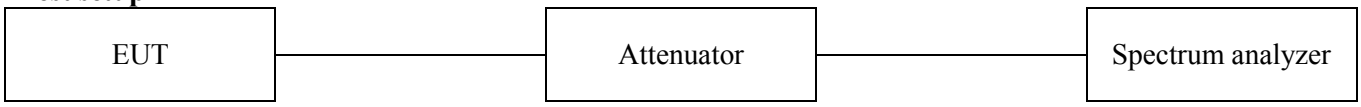
High channel





3.3. 6 dB bandwidth

Test setup



Test procedure

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

KDB 558074_v03r01 – section 8.2 option 1.

Option 1:

a) Set RBW = 100 ㎑.
b) Set the video bandwidth(VBW) ≥ 3 × RBW.
c) Detector = peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) 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 6 ㏈ relative to the maximum level measured in the fundamental emission.

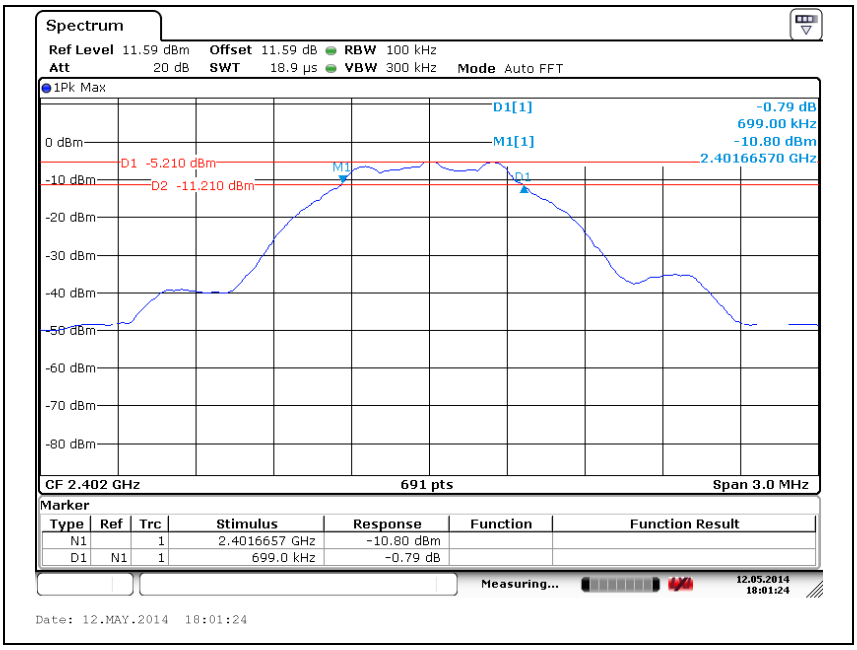
Limit

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

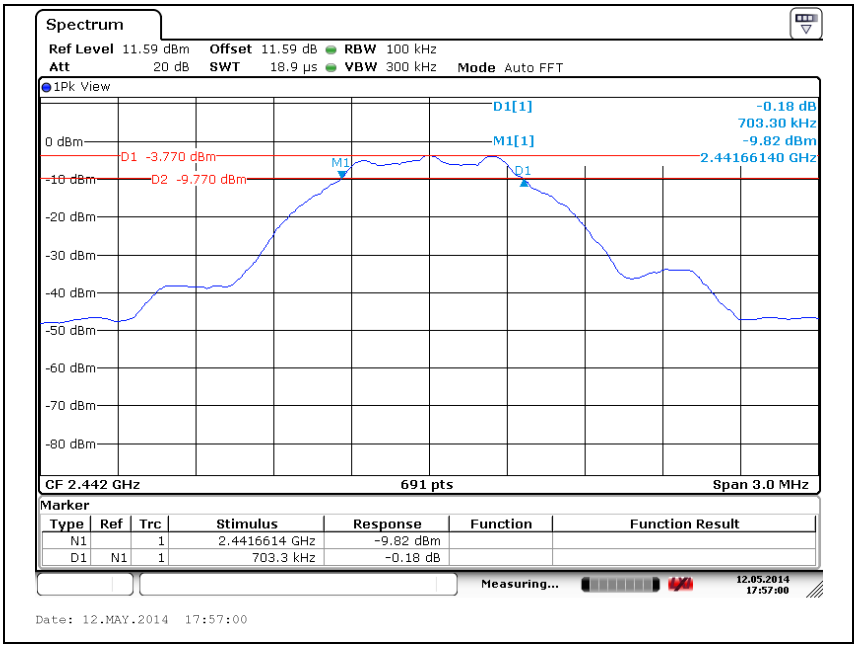
Test results

Test Mode	Frequency(㎒)	6 dB bandwidth(㎒)	Limit(㎒)
LE	2 402	0.699	0.5
	2 442	0.703	
	2 480	0.686	

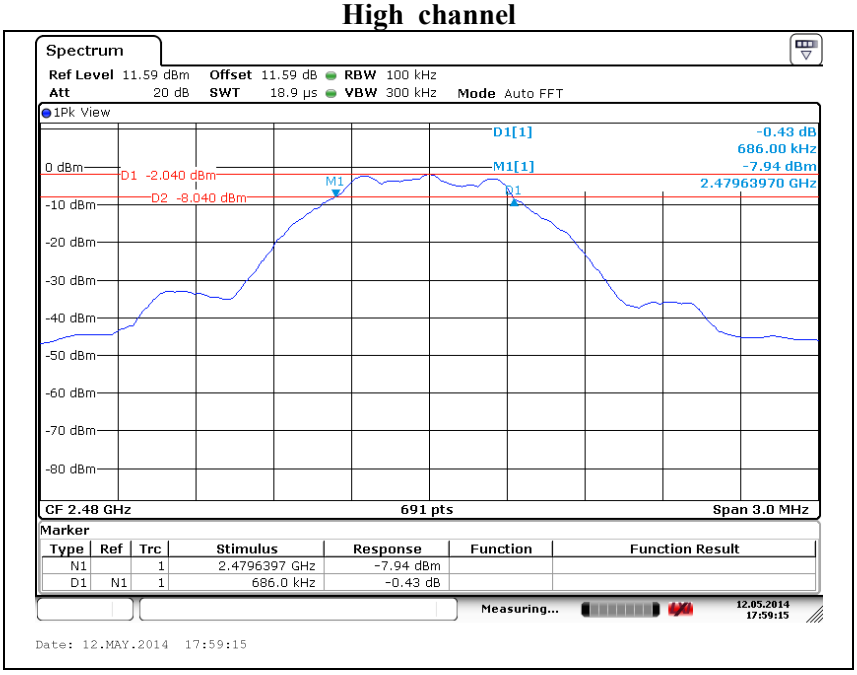
Low channel



Middle channel

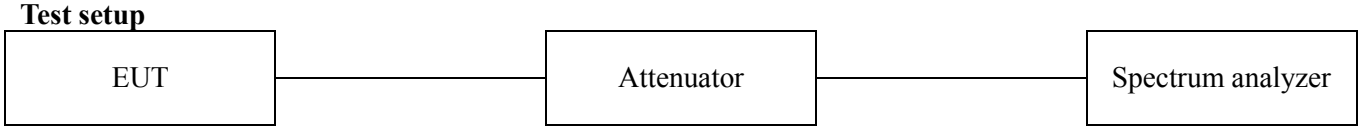


High channel



3.4. Peak Output power

Test setup



Test procedure

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

KDB 558074_v03r01 – section 9.1.1

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ 3 RBW.
c) Set span ≥ 3 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

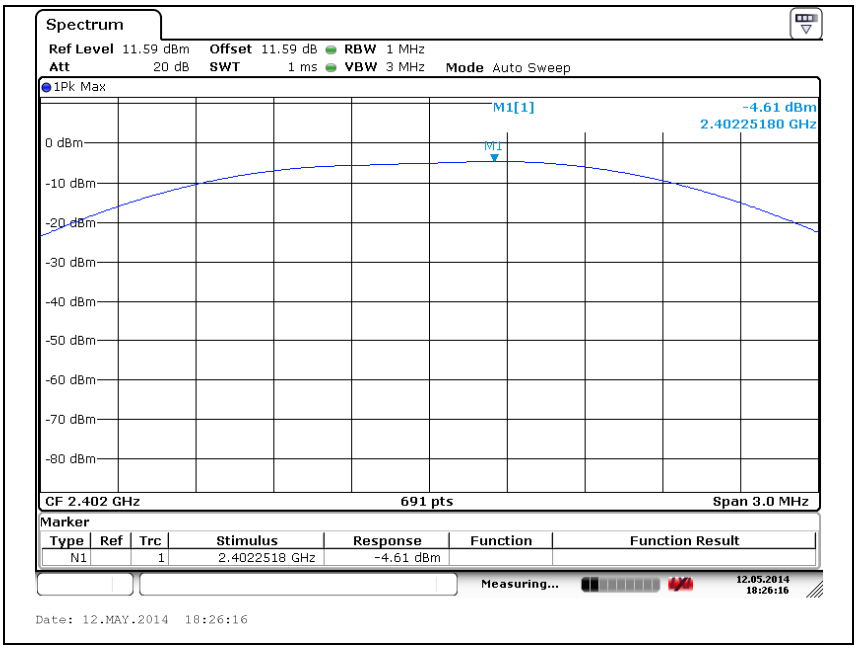
Limit

According to §15.247(b)(3), For systems using digital modulation in the 902~928 ㎒, 2 400~2 483.5 ㎒, and 5 725~5 850 ㎒ 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 ㏈i. Except as shown in paragraph (c) of this section, if transmit-ting antennas of directional gain greater than 6 ㏈i 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 ㏈i.

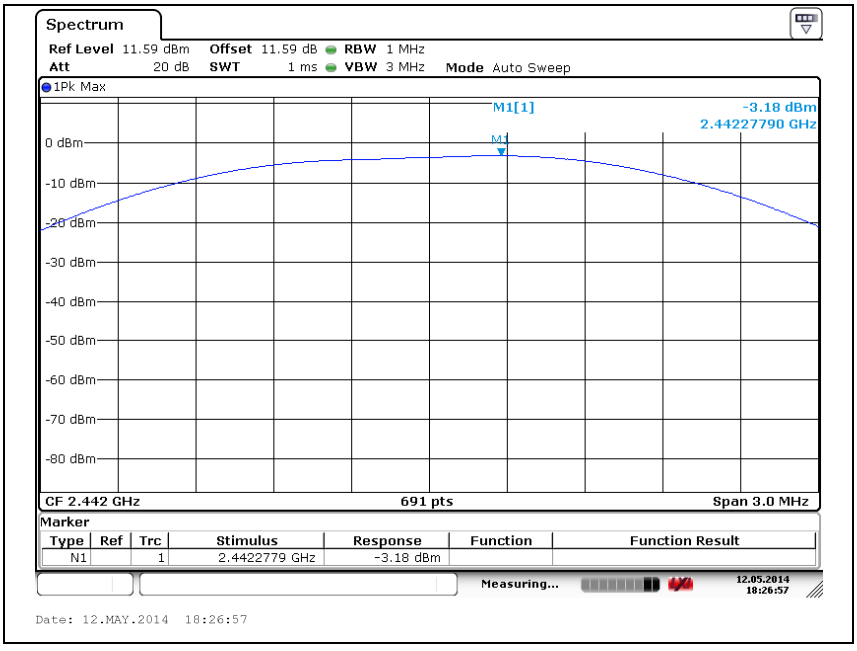
Test results

Test Mode	Frequency(㎒)	Conducted power (dBm)	Limit(dBm)
LE	2 402	-4.61	30
	2 442	-3.18	
	2 480	-1.51	

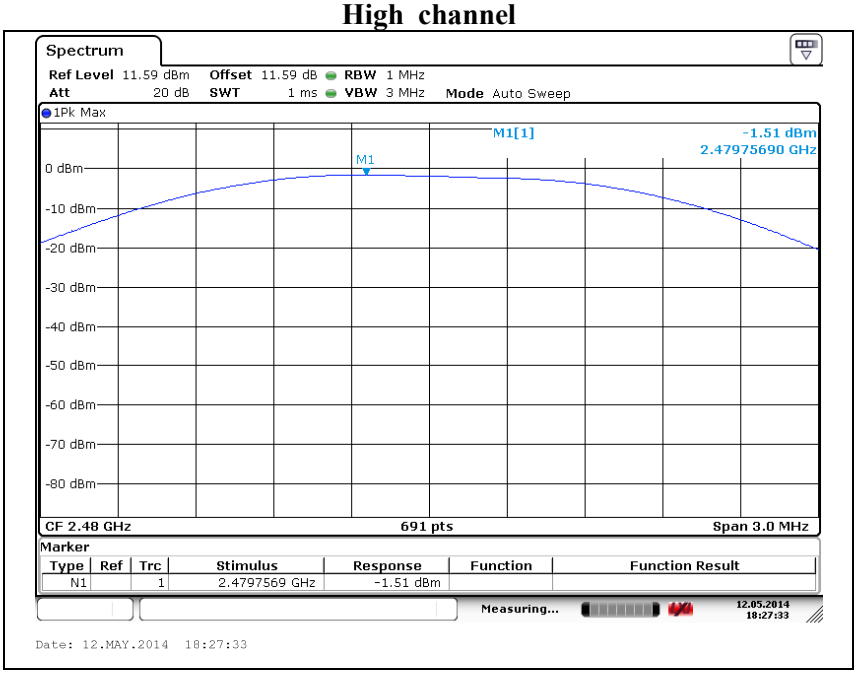
Low channel



Middle channel

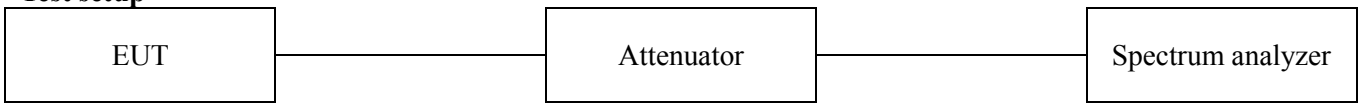


High channel



3.5. Power spectral density

Test setup



Test procedure

KDB 558074_v03r01 – section 10.2

Measurement procedure

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS channel bandwidth.
c) Set the RBW : 3 ㎑ ≤ RBW ≤ 100 ㎑
d) Set the VBW ≥ 3 × RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level.
j) If measured value exceeds limit, reduce RBW(no less than 3 ㎑) and repeat.

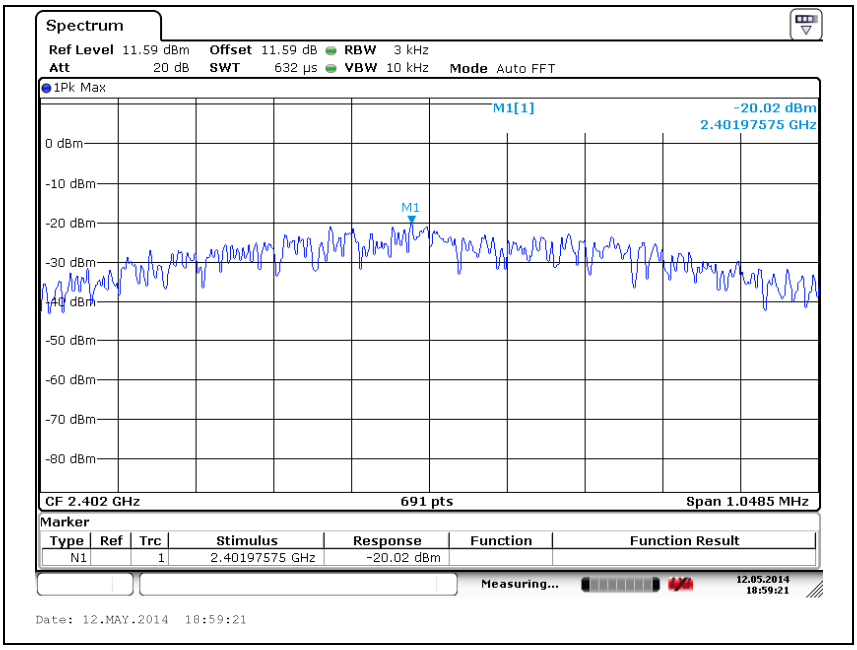
Limit

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 ㏈m in any 3 ㎑ 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.

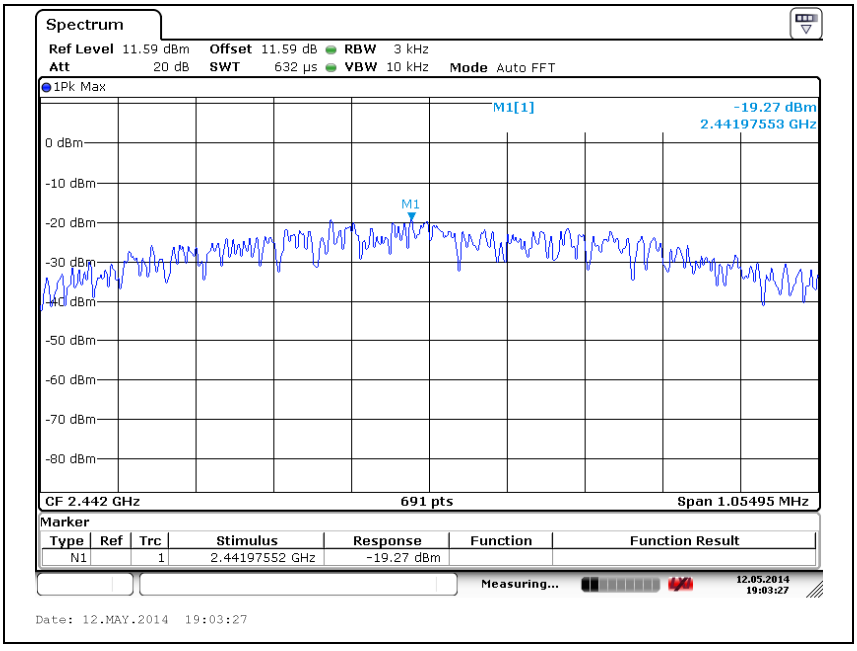
Test results

Test Mode	Frequency(㎒)	Conducted power (dBm)	Limit(dBm)
LE	2 402	-20.02	8
	2 442	-19.27	
	2 480	-17.36	

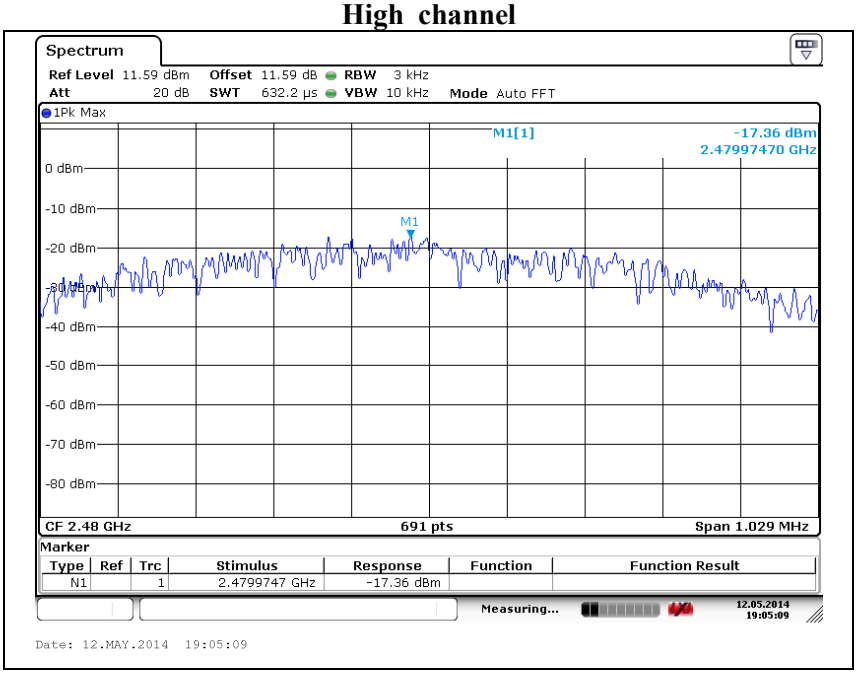
Low channel



Middle channel



High channel



3.6. AC conducted emissions

Frequency range of measurement
150 ㎑ to 30 ㎒

Instrument settings
IF Band Width: 9 ㎑

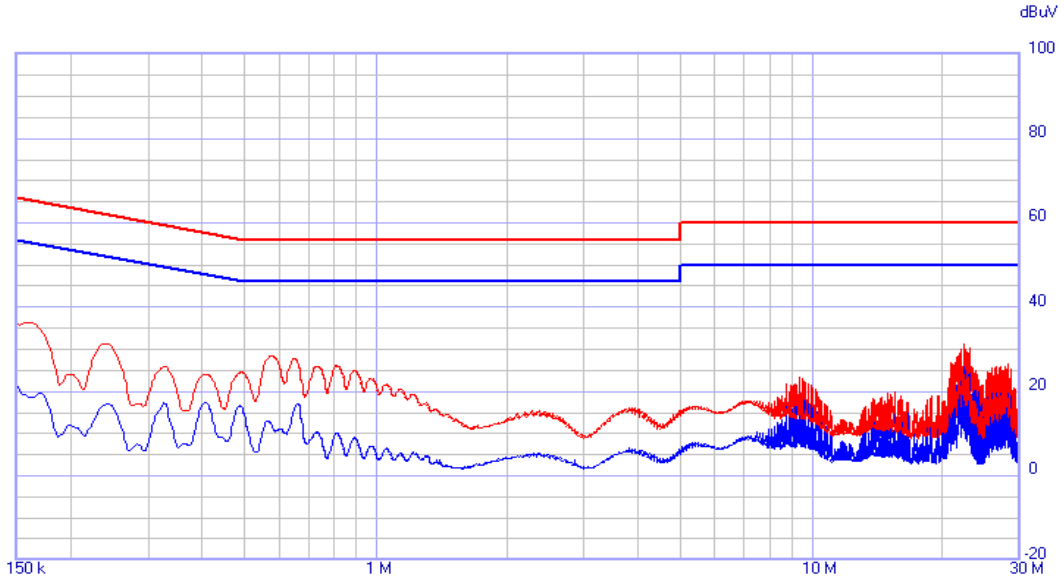
Test procedures
The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m. Amplitude measurements were performed with a quasi-peak detector and an average detector.

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

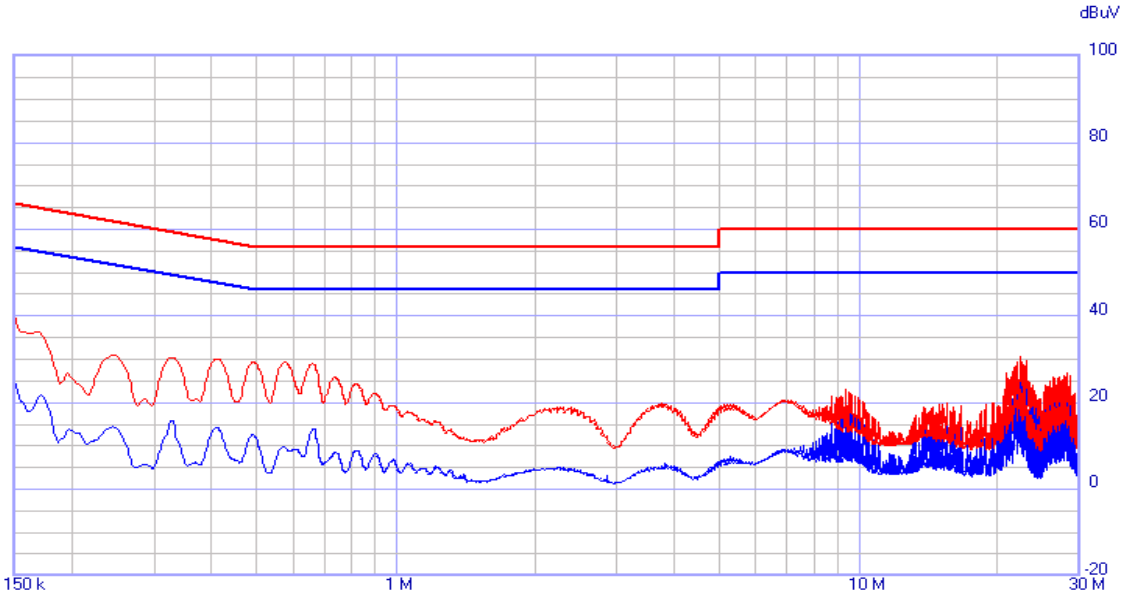
Note.
a) Decreases with the logarithm of the frequency.
b) All AC Conducted emission at channels are almost the same, so that high channel was chosen at representative in final test.

Test results



Detector Mode	Frequency(㎒)	Level(dB㎶)	Limit(dB㎶)	Delta(dB)
Q.P	0.160	36.34	65.46	29.12
	0.244	31.17	61.96	30.79
	0.327	25.93	59.53	33.60
	0.657	27.37	56.00	28.63
	9.438	22.93	60.00	37.07
	22.256	31.31	60.00	28.69
AV	0.160	18.59	55.46	36.87
	0.244	17.07	51.96	34.89
	0.327	17.20	49.53	32.33
	0.657	17.14	46.00	28.86
	9.438	18.29	50.00	31.71
	22.256	25.96	50.00	24.04

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



Detector Mode	Frequency(㎒)	Level(dB㎶)	Limit(dB㎶)	Delta(dB)
Q.P	0.168	36.44	65.06	28.62
	0.242	30.87	62.03	31.16
	0.325	30.40	59.58	29.18
	0.411	30.07	57.63	27.56
	0.663	28.83	56.00	27.17
	22.254	30.58	60.00	29.42
AV	0.168	21.30	55.06	33.76
	0.242	14.30	52.03	37.73
	0.325	15.79	49.58	33.79
	0.411	14.08	47.63	33.55
	0.663	14.00	46.00	32.00
	22.254	24.67	50.00	25.33

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

Appendix A. Measurement equipment

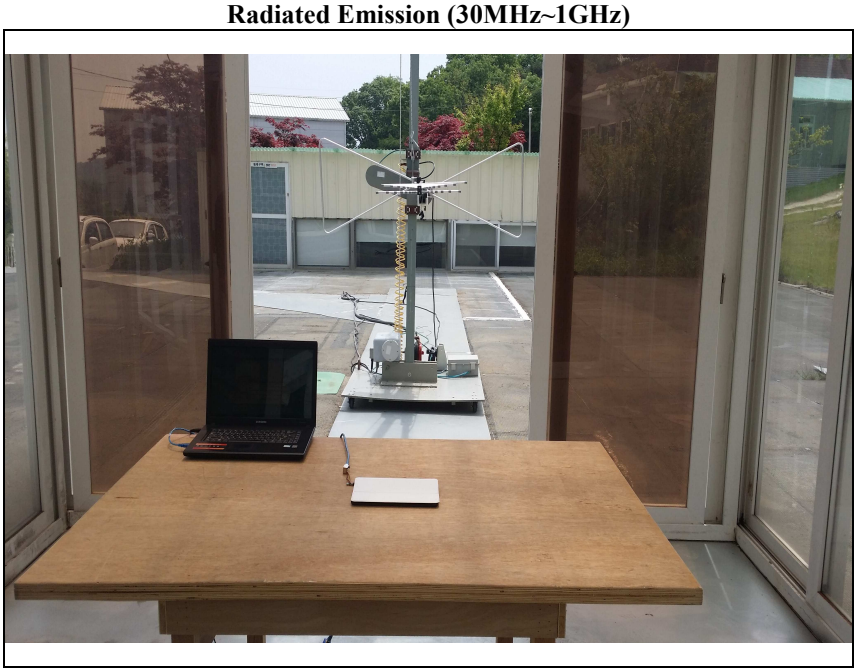
Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV30	101389	1 year	2015.01.06
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2015.04.30
Loop antenna	R&S	HFH2-Z2.335.4711.52	826532	2 year	2015.04.25
Trilog-broadband antenna	Schwarzbeck	VULB 9168	9168-385	2 year	2015.05.09
Horn antenna	A.H.	SAS-571	414	2 year	2015.02.28
Preamplifier	Schwarzbeck	BBV 9721	9728-245	2 year	2014.09.23
Attenuator	HP	8495B	110504721	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

Peripheral devices

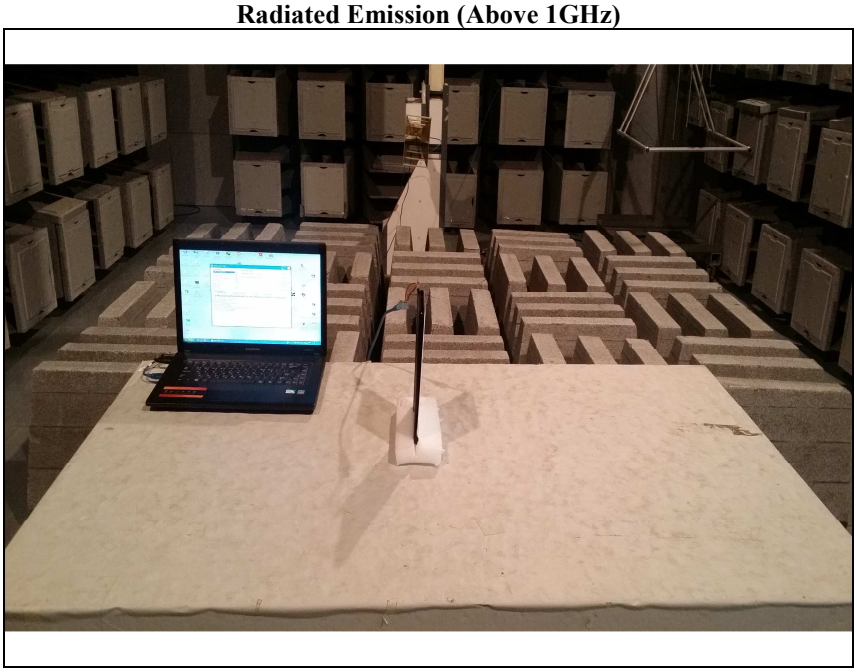
Device	Manufacturer	Model No.	Serial No.
Notebook(Laptop)	Samsung Electronics	R519	ZKPA93ES900086Z

Appendix B. Test setup photo

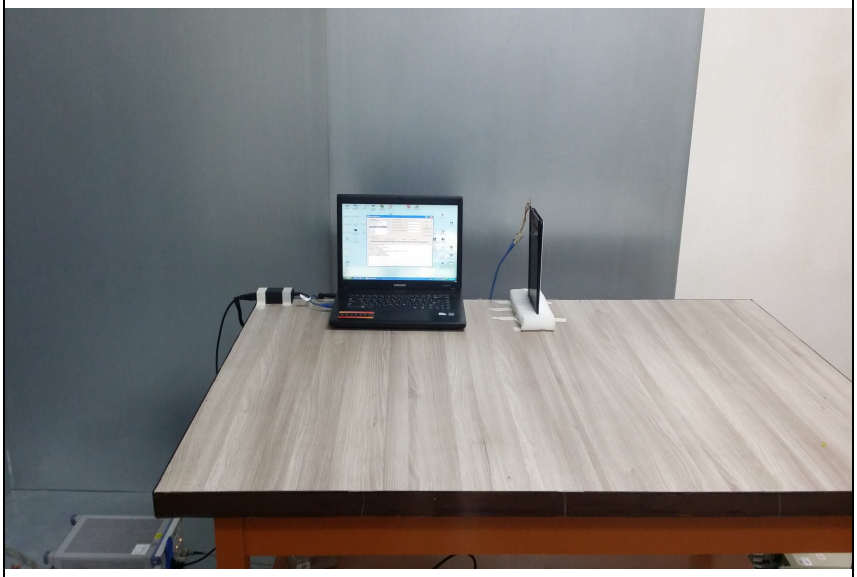
Radiated Emission (30MHz~1GHz)

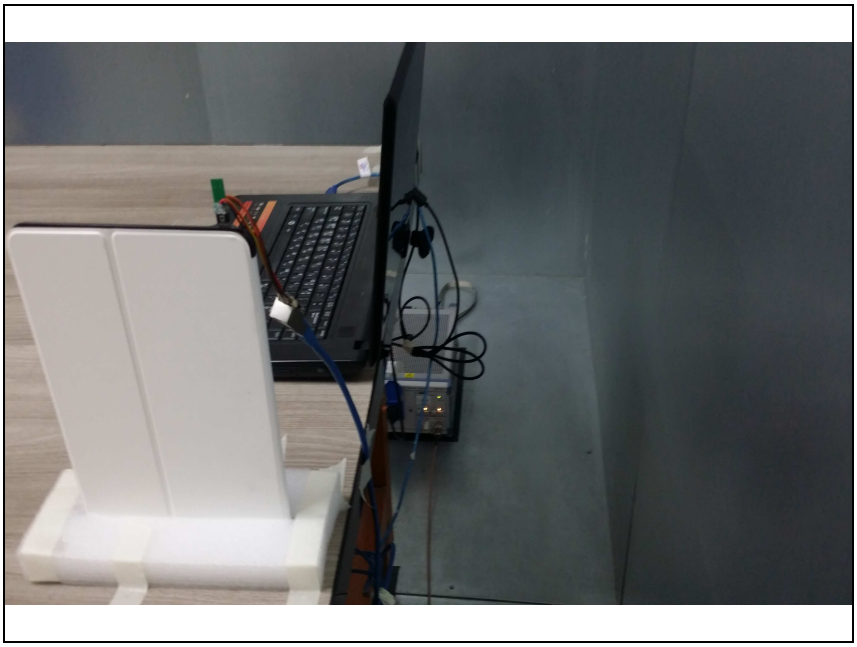


Radiated Emission (Above 1GHz)



AC conducted Emission





Appendix C. Duty Cycle

Frequency (㎒)	Mode	Duty cycle(X) = Tx_{on} time / (Tx_{on} time + Tx_{off} time)		
		Tx_{on} time (㎳)	Tx_{on} time + Tx_{off} time (㎳)	X
2 441	LE	0.623	0.837	0.744