TEST REPORT

Part 15 Subpart C 15.247

Equipment under test	Bluetooth Keyboard Case
Model name	CLNK2100
FCC ID	PZYCLNK2100
Applicant	Core Logic, Inc.
Manufacturer	Core Logic, Inc.
Date of test(s)	2014.12.10 ~ 2014.12.19
Date of issue	2014.12.19

Issued to

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Test and report completed by :	**Report approval by :**
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Revision history

Revision	Date of issue	Test report No.	Description
-	2014.12.19	KES-RF-14T0059	Initial

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1. General information

Applicant:	Core Logic, Inc.
Applicant address:	11st FI, 1-B U-Space building 660 Daewangpangy-ro, Bundang-gu, Seongsam-si Gyeonggi-do 463-400 korea
Test site:	KES Co., Ltd.
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FCC rule part(s):	15.247
Model:	CLNK2100
FCC ID:	PZYCLNK2100
Test device serial No.:	☐ Production ☒ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	Bluetooth Keyboard Case
Frequency range	2402 ㎒ ~ 2480 ㎒
Modulation technique	GFSK
Number of channels	40
Antenna specification	Antenna type: PCB, Peak gain: 2 dBi
Power source	DC 3.7 V(Battery)

The device contains the following capabilities: Only Bluetooth LE

1.2. Information about derivative model

N/A

1.3. Device modifications

N/A

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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

Note:

1. The EUT was tested per the guidance of KDB 558074 v03r02. ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions testing and/or AC line conducted testing.
2. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.

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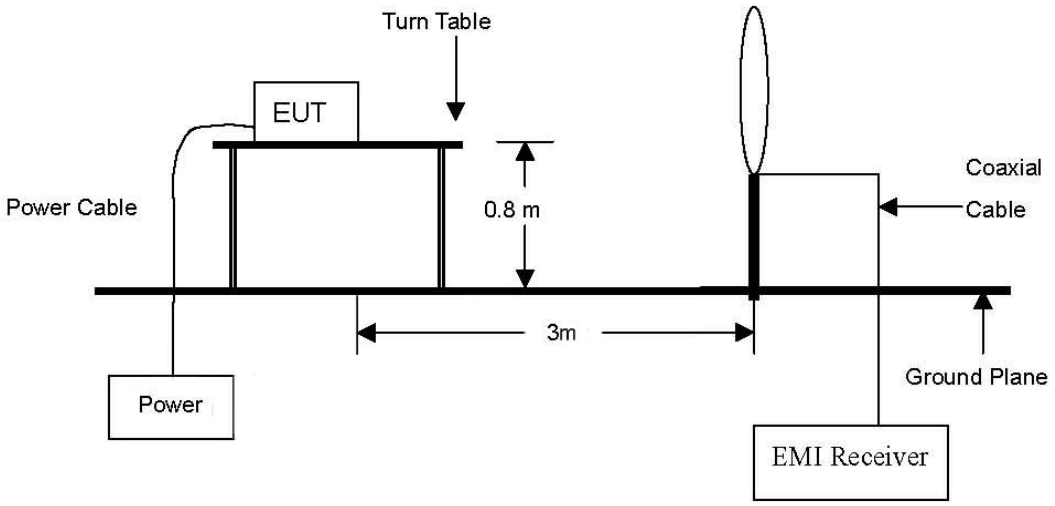
3. Test results

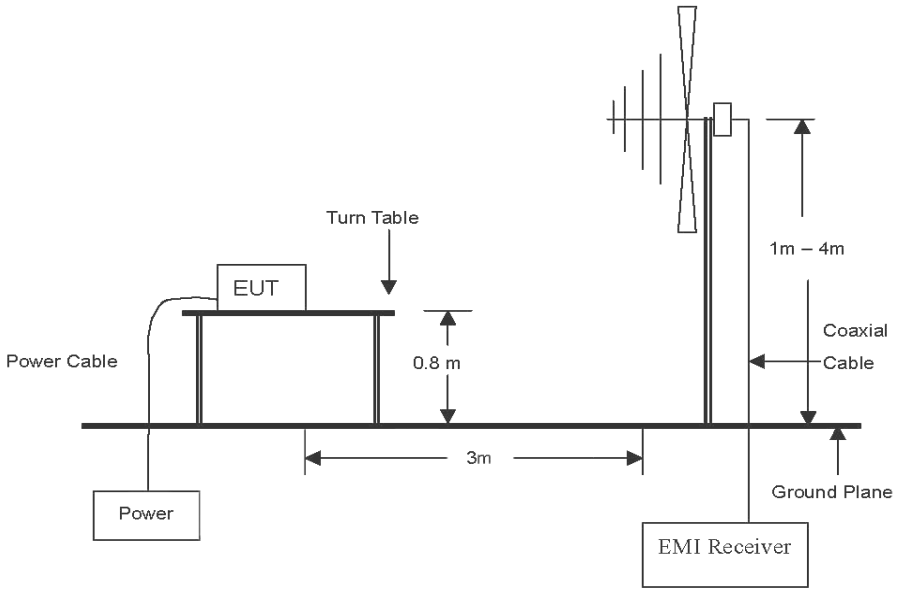
3.1 Radiated spurious emissions

Test setup

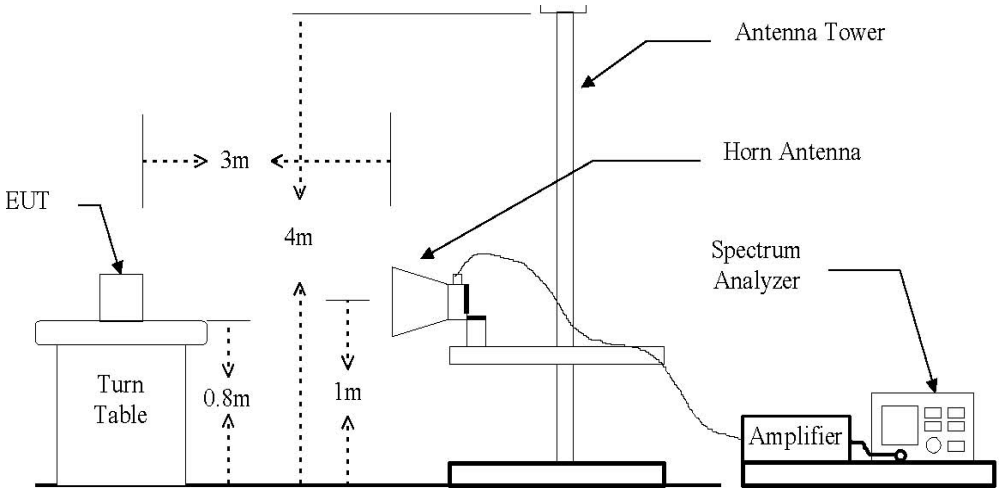
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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
KDB 558074 v03r02 – section 12.1 and 12.2.7

Test settings
Peak Field Strength Measurements per Section 12.2.4 of KDB 558074 v03r02
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1 ㎒
3. VBW = 3 ㎒
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Average Field Strength Measurements per Section 12.2.5.1 of KDB 558074 v03r02
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1 ㎒
3. VBW = 3 ㎒
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be > 2 x span/RBW)
6. Sweep time = auto 7. Trace (RMS) averaging was performed over at least 100 traces

Note:
1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of KDB 558074 v03r02 were not used to evaluate this device for compliance to radiated limits. All radiated spurious emissions levels were measured in a radiated test setup.
2. The spectrum is measured from 9 ㎑ to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1 ㎓. Above 1 ㎓, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ of the respective limits were not reported.
3. Emissions below 18 ㎓ were measured at a 3 meter test distance while emissions above 18 ㎓ were measured at a 1 meter test distance with the application of a distance correction factor.
4. Average test would be performed if the peak result were greater than the average limit.

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5. "*" means restricted band edge.
5. Field strength(dBμV/m) = Level(dBμV) + Correction factors(dB/m) + Cable loss(dB) + F_d(dB)
6. Correction factors(dB/m) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB)
7. Margin(dB) = Limit(dBμV/m) - Field strength(dBμV/m)
8. $F_d = 40\log(D_m / D_s)$
   Where:
   F_d = Distance factor in dB
   D_m = Measurement distance in meters
   D_s = Specification distance in meters

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 (MHz)	Distance (Meters)	Radiated (μV/m)
0.009 ~ 0.490	300	2 400 / F(kHz)
0.490 ~ 1.705	30	24 000 / 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.

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Test results (Below 30 ㎒)

Mode:	Bluetooth LE
Transfer rate:	1 Mbps
Distance of measurement:	3 meter
Operating frequency:	2 480 ㎒ (Worst case)
Channel:	39

Frequency (㎒)	Level (dBμV)	Ant. Pol.	Correction factors (dB/m)	F_d (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No signal detected							

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Test results (Below 1 000 ㎒)

Mode:	Bluetooth LE
Transfer rate:	1 Mbps
Distance of measurement:	3 meter
Operating frequency:	2 480 ㎒ (Worst case)
Channel:	39

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
160.950	10.90	V	13.27	1.28	25.45	43.50	19.45
176.470	18.95	H	11.36	1.34	31.65	43.50	20.31
184.230	19.71	H	10.58	1.37	31.66	43.50	19.38
353.010	23.09	H	13.90	1.93	38.92	46.00	18.97
356.890	14.25	V	13.98	1.94	30.17	46.00	18.15
364.650	21.91	H	14.14	1.96	38.01	46.00	16.36
558.650	15.46	V	17.90	2.48	35.84	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.

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Test results (Above 1 000 ㎒)

Mode: Bluetooth LE
Transfer rate: 1 Mbps
Distance of measurement: 3 meter
Operating frequency: 2 402 ㎒
Channel: 0

Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detector mode	Pol.	AFCL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1841.7	46.88	Perak	H	0.21	47.09	74.00	26.91
1841.7	48.02	Perak	V	0.21	48.23	74.00	25.77
2166.3	37.92	Perak	H	2.65	40.57	74.00	33.43
2166.3	43.50	Perak	V	2.65	46.15	74.00	27.85
2316.0	39.94	Perak	H	3.29	43.23	74.00	30.77
2355.1	39.47	Perak	V	3.44	42.91	74.00	31.09
4803.7	39.14	Perak	H	13.54	52.68	74.00	21.32
4803.7	40.33	Perak	V	13.54	53.87	74.00	20.13

Mode: Bluetooth LE
Transfer rate: 1 Mbps
Distance of measurement: 3 meter
Operating frequency: 2 440 ㎒
Channel: 19

Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detector mode	Pol.	AFCL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1716.8	52.50	Perak	H	-1.02	51.48	74.00	22.52
1831.7	45.36	Perak	V	0.11	45.47	74.00	28.53
1846.7	45.16	Perak	H	0.26	45.42	74.00	28.58
2161.3	42.24	Perak	V	2.63	44.87	74.00	29.13

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Mode:	Bluetooth LE
Transfer rate:	1 Mbps
Distance of measurement:	3 meter
Operating frequency:	2 480 ㎒
Channel:	39

Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detector mode	Pol.	AFCL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1551.9	47.64	Perak	H	-2.64	45.00	74.00	29.00
1831.7	43.28	Perak	V	0.11	43.39	74.00	30.61
1841.7	46.26	Perak	H	0.21	46.47	74.00	27.53
2161.3	42.46	Perak	V	2.63	45.09	74.00	28.91
2485.2	39.34	Perak	V	4.18	43.52	74.00	30.48
2486.9	39.63	Perak	H	4.19	43.82	74.00	30.18
4958.5	39.30	Perak	V	14.57	53.87	74.00	20.13

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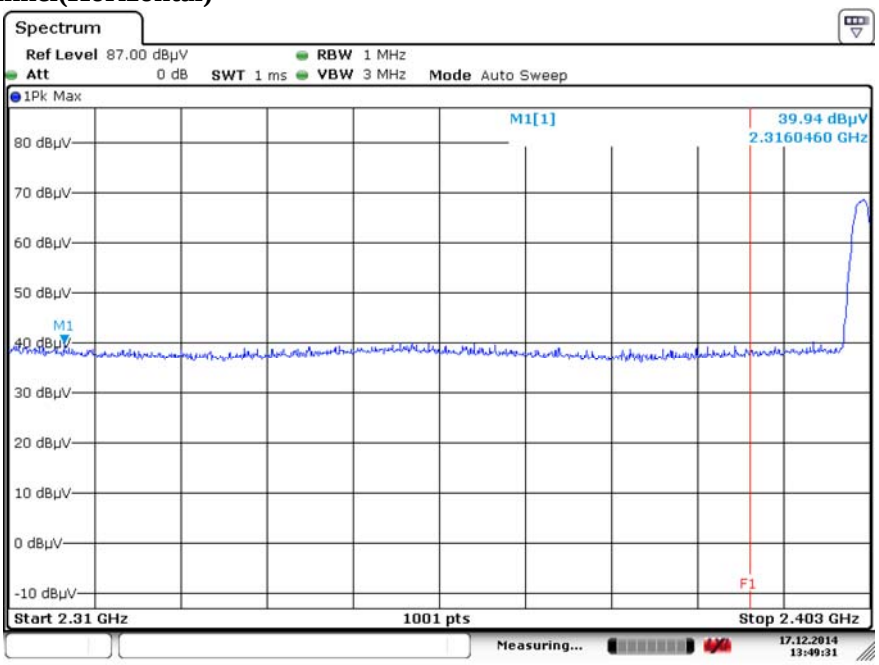
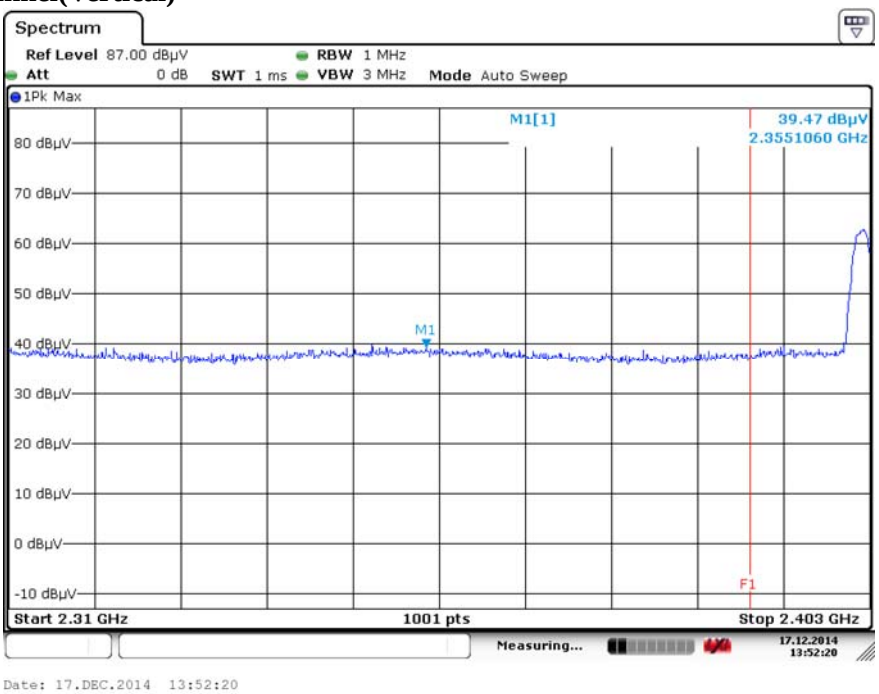
Test results band edge emissions

- **Low channel(Horizontal)**



- **Low channel(Vertical)**



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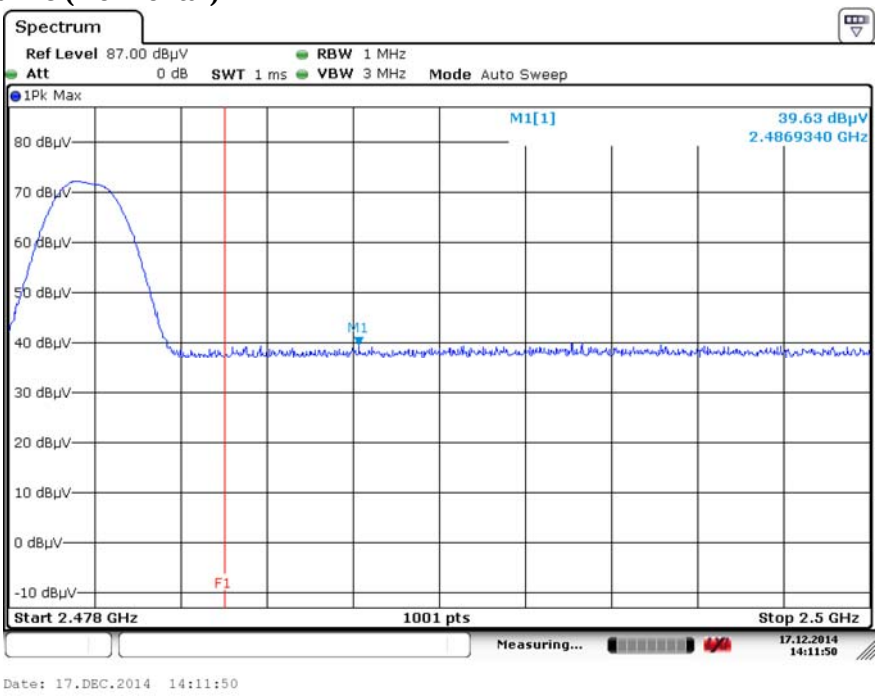
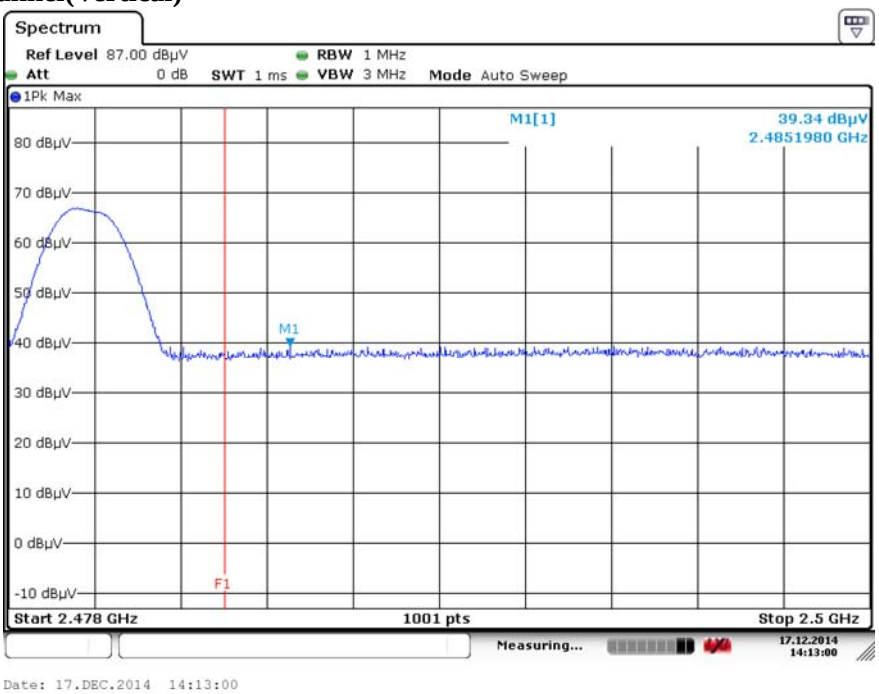
- **High channel(Horizontal)**



Date: 17.DEC.2014 14:11:50

- **High channel(Vertical)**



Date: 17.DEC.2014 14:13:00

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3.2 Conducted spurious emissions & band edge

Test setup

EUT	—	Attenuator	—	Spectrum analyzer

Test procedure

Band edge

KDB 558074 v03r02 – Section 11.3

Test setting

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100 ㎑
4. VBW = 1 ㎒
5. Detector = Peak
6. Number of sweep points ≥ 2 × Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Out of band emissions

KDB 558074 v03r02 – Section 11.3
KDB 662911 v02r01 – Section E)3)b)

Test setting

1. Start frequency was set to 30 ㎒ and stop frequency was set to 25 ㎓ for 2.4 ㎓ frequencies and 40 ㎓ for 5 ㎓ frequencies (separated into two plots per channel)
2. RBW = 1 ㎒z
3. VBW = 3 ㎒
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

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))

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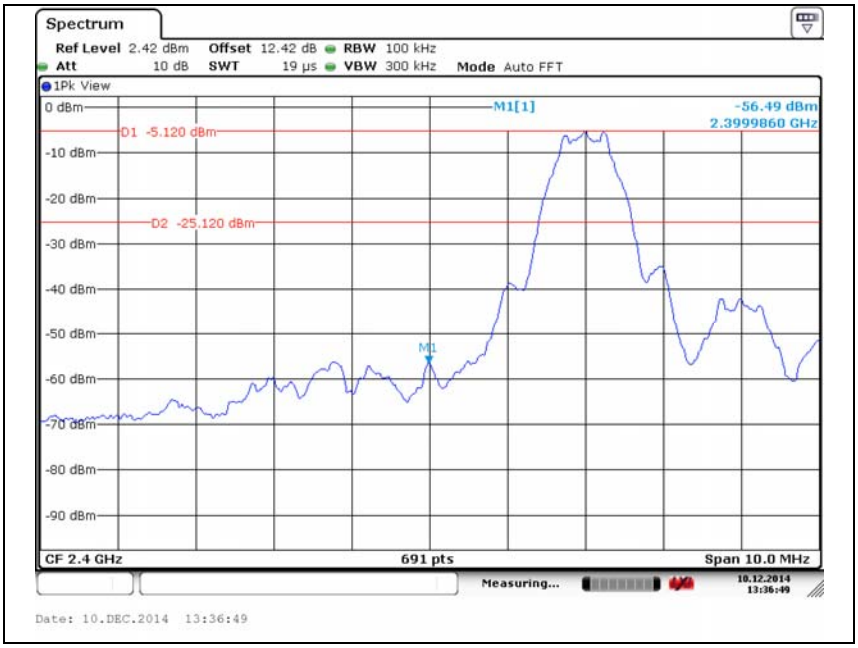
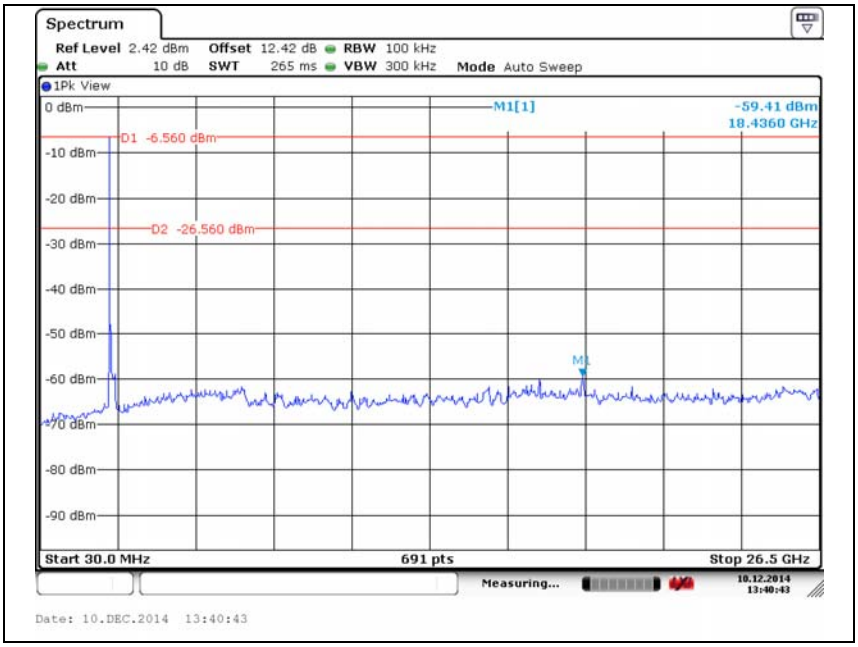
Test results

Low channel





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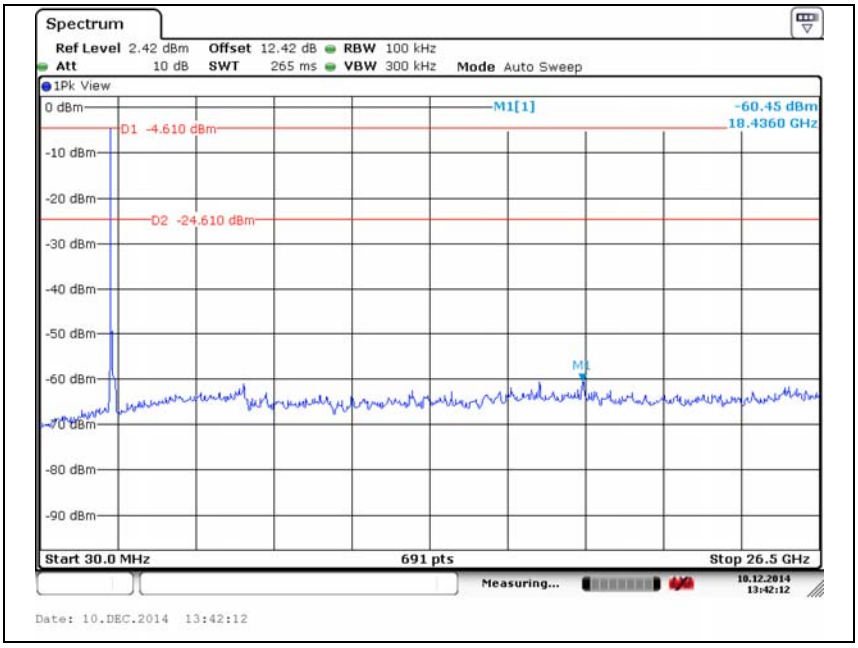
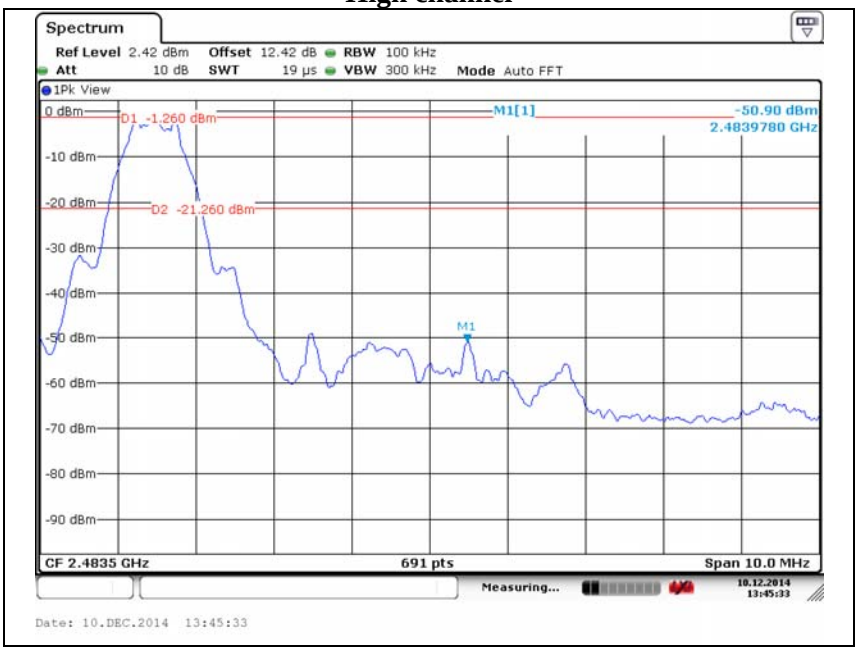
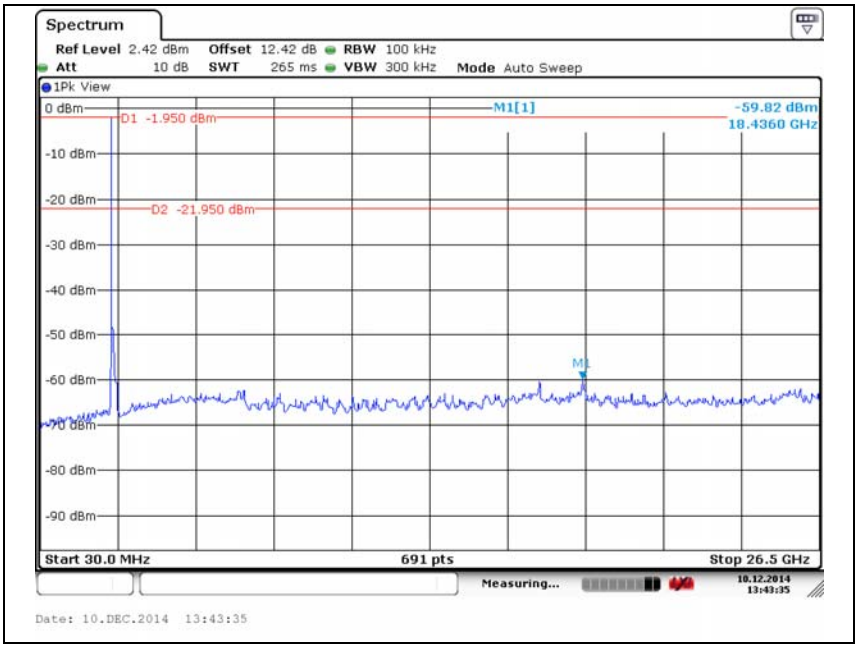
Middle channel



N/A

High channel





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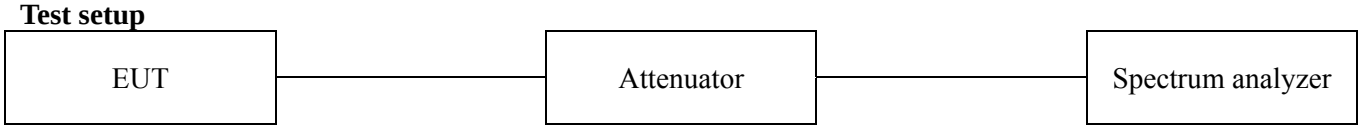
3.3. 6 dB bandwidth

Test setup



Test procedure

KDB 558074 v03r02 – 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 dB 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 dB bandwidth shall be at lea st 500 ㎑.

Test results

Test Mode	Frequency(㎒)	6 dB bandwidth(㎒)	Limit(㎒)
LE	2 402	0.690	0.5
	2 442	0.703	
	2 480	0.695	

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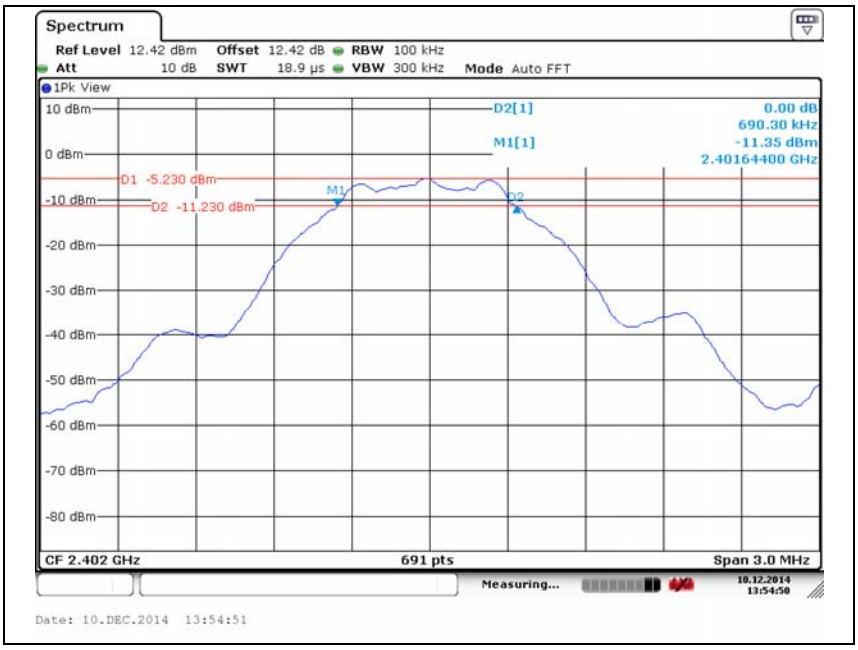
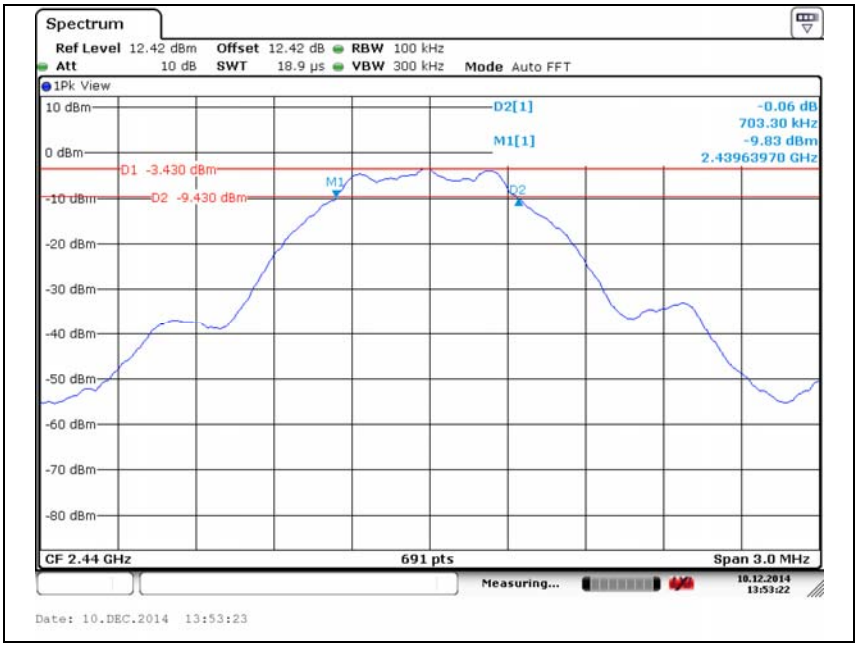
Low channel



Middle channel



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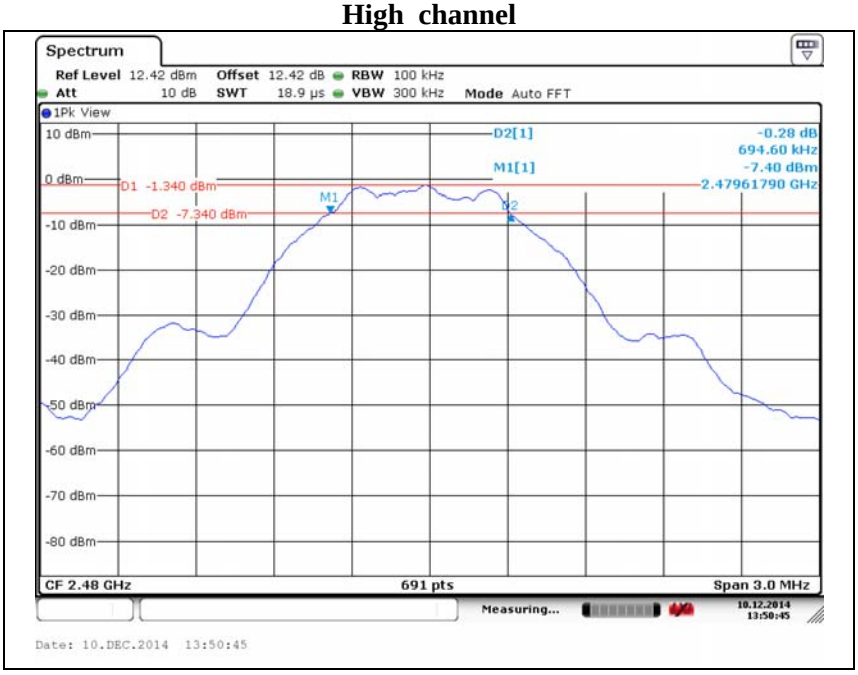
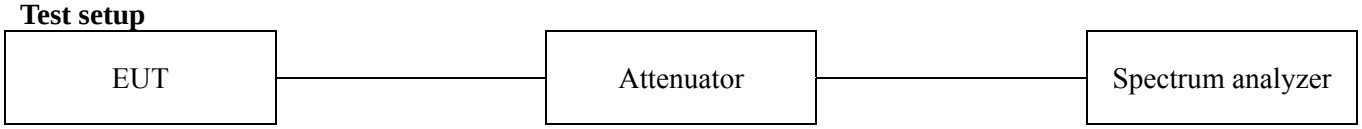
High channel



3.4. 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.

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The test results in the report only apply to the tested sample.

Test results

Test Mode	Frequency(㎒)	Conducted power (dBm)	Limit(dBm)
LE	2 402	-4.75	30
	2 442	-3.03	
	2 480	-0.98	

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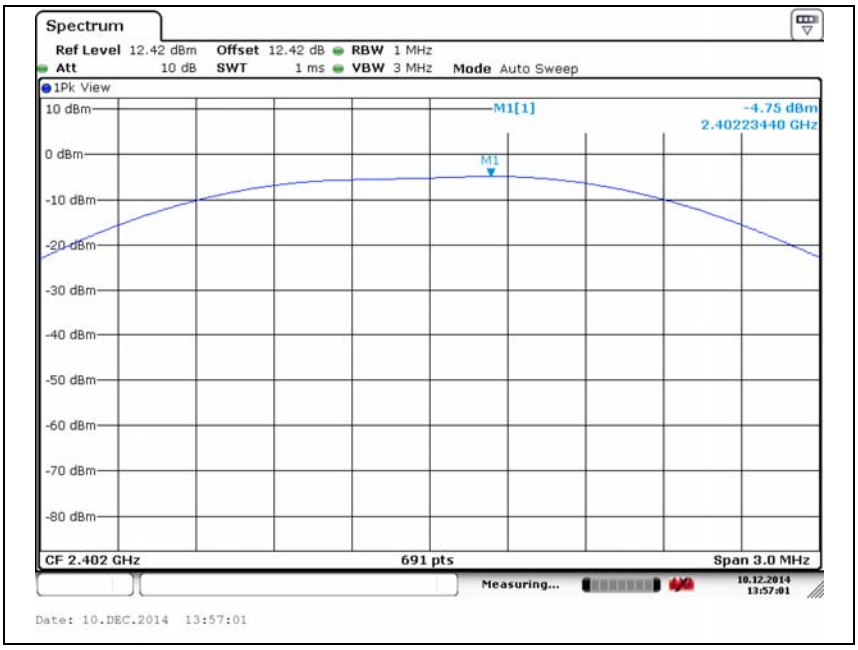
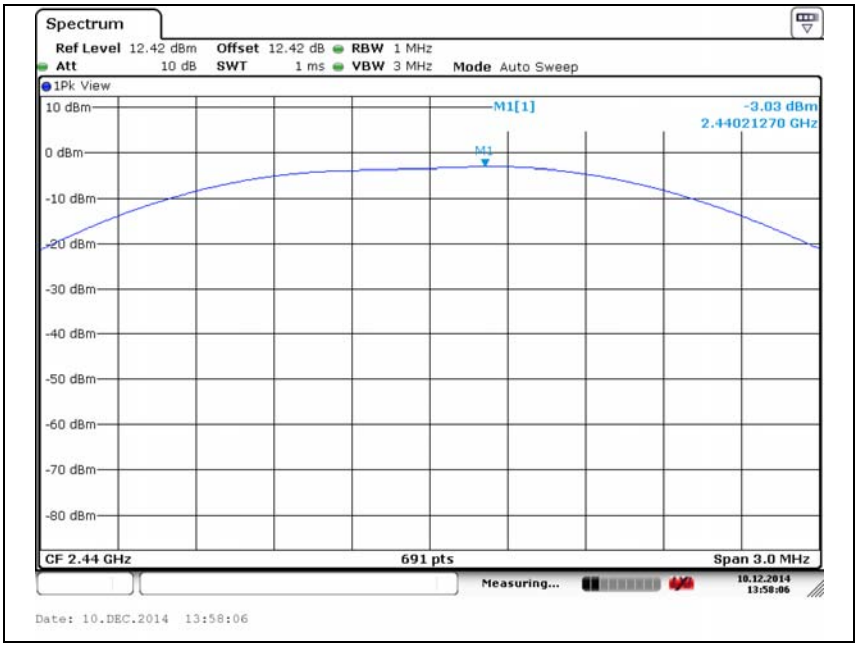
Low channel



Middle channel



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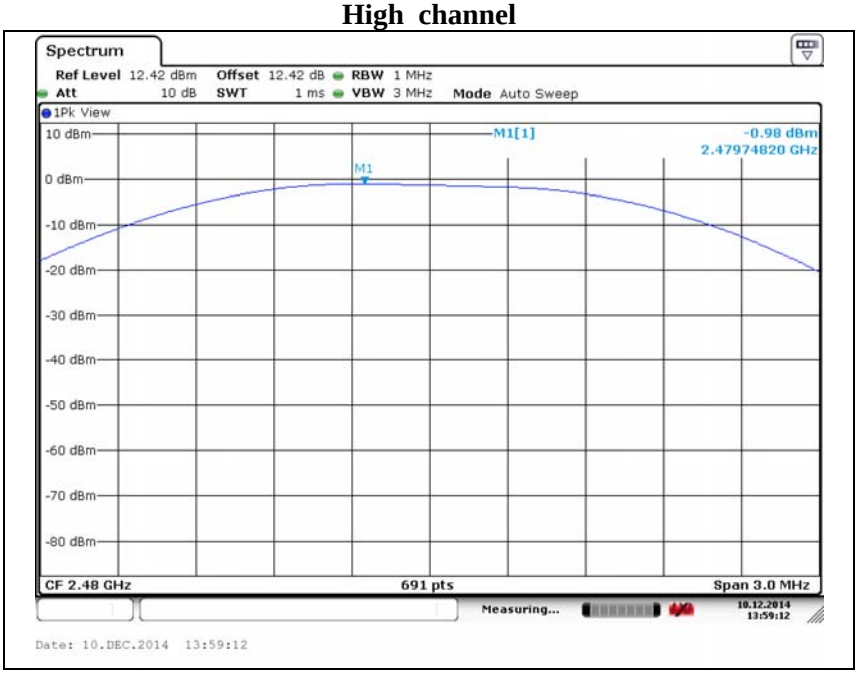
High channel



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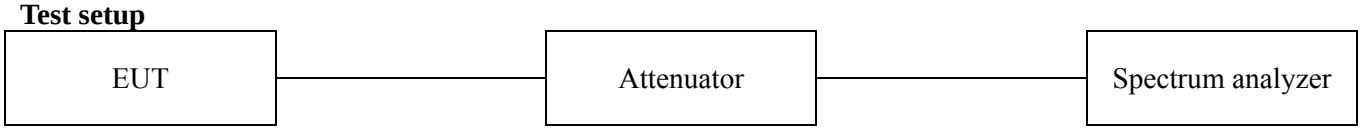
3.5. Power spectral density

Test setup



Test procedure

KDB 558074_v03r02 – 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.

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Test results

Test Mode	Frequency(㎒)	Conducted power (dBm)	Limit(dBm)
LE	2 402	-20.62	8
	2 442	-18.90	
	2 480	-16.79	

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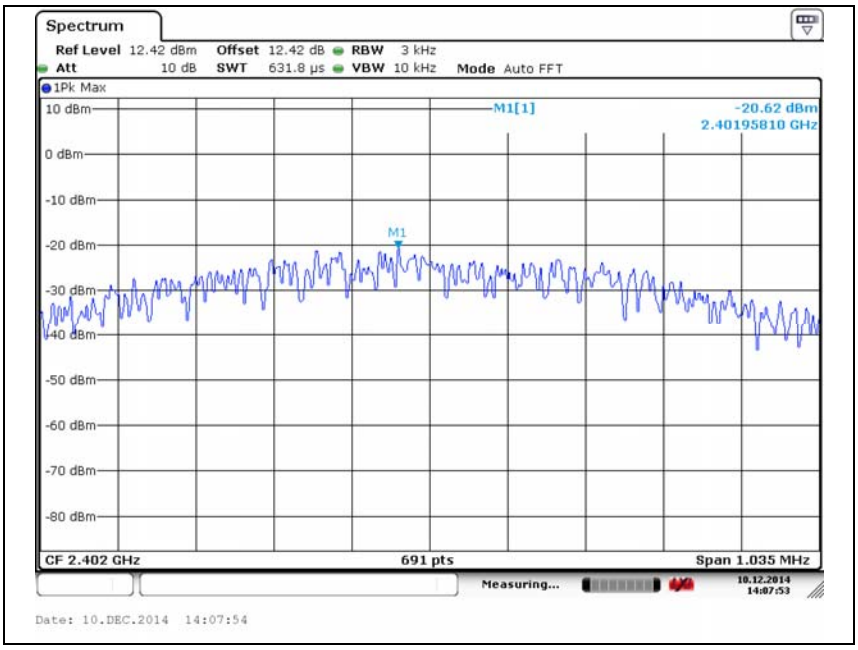
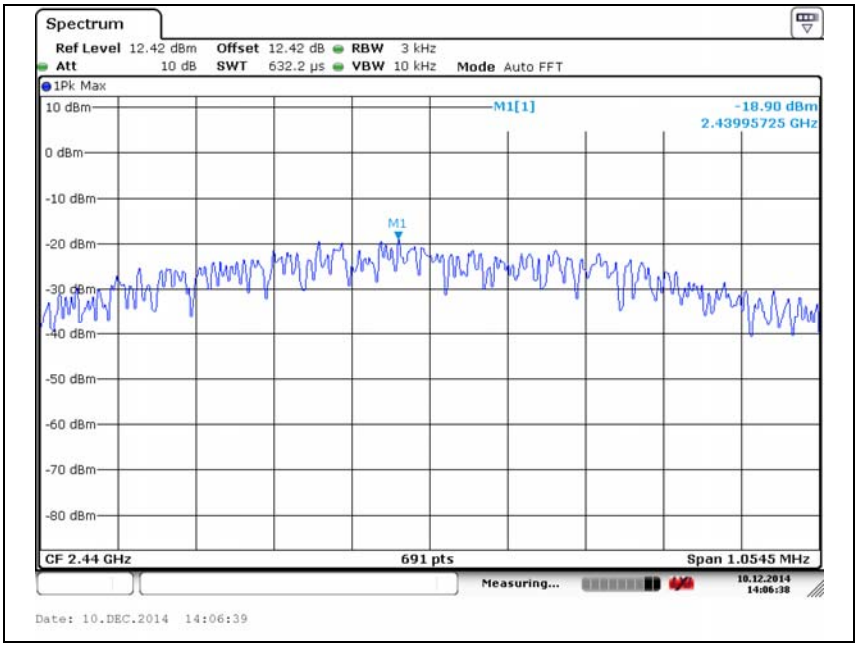
Low channel



Middle channel



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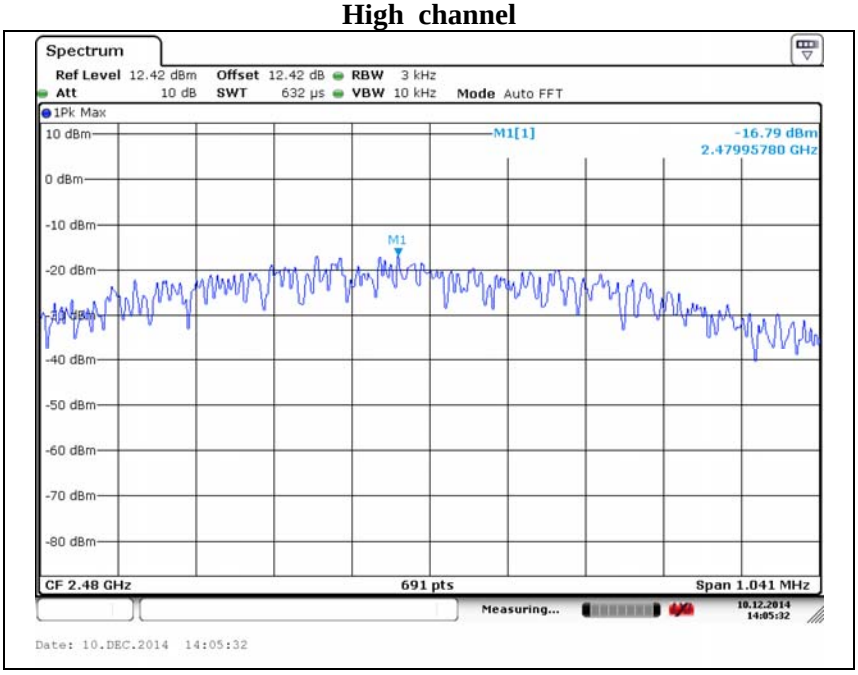
High channel



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 (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

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.

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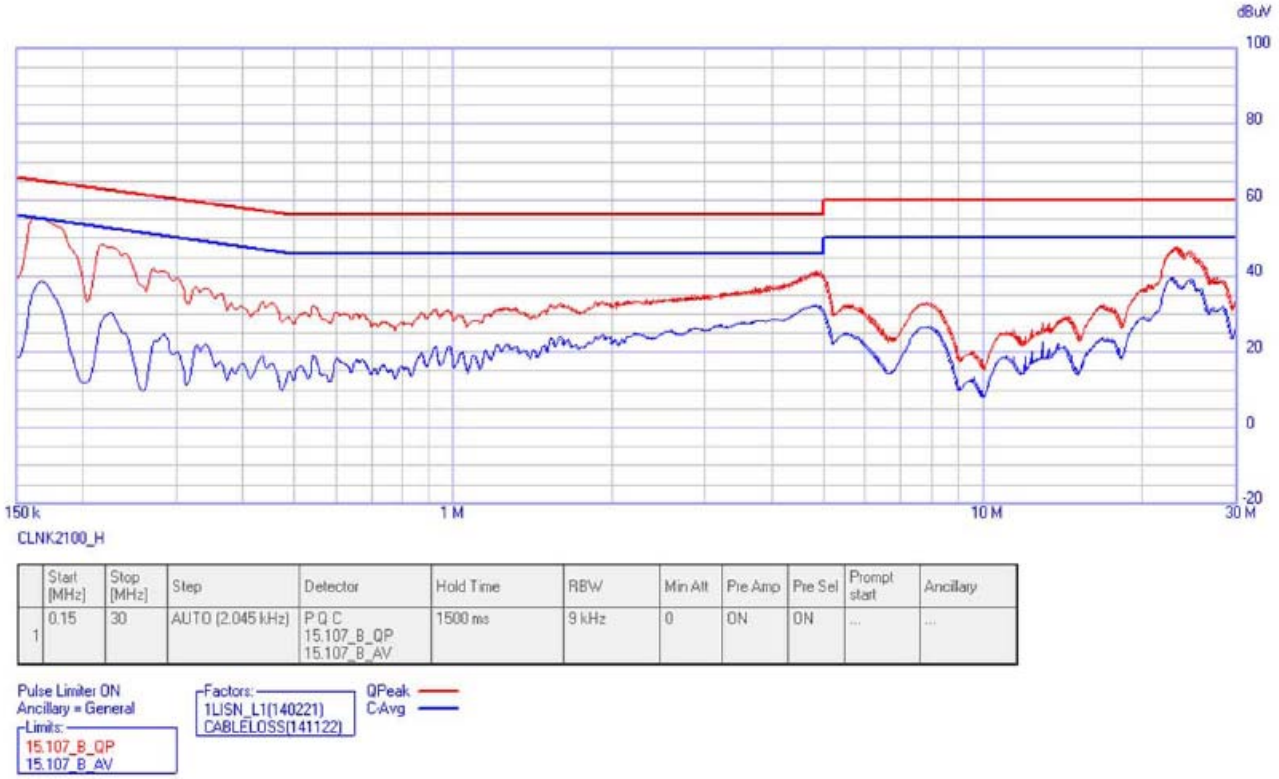
Test results



Frequency [MHz]	Q-Peak [dBμV]	Limit [dBμV]	Margin [dB]	C-Avg [dBμV]	Limit [dBμV]	Margin [dB]	Factor (LISN) [dB]	Factor (Cable Loss) [dB]
0.152	40.540	65.890	-25.350	18.970	55.890	-36.920	9.660	0.020
0.162	55.410	65.350	-9.940	36.580	55.350	-18.770	9.660	0.030
0.217	48.270	62.910	-14.640	28.750	52.910	-24.160	9.650	0.030
0.271	42.140	61.100	-18.960	22.300	51.100	-28.800	9.650	0.030
3.710	36.910	56.000	-19.090	27.980	46.000	-18.020	9.670	0.130
4.862	41.290	56.000	-14.710	32.280	46.000	-13.720	9.670	0.170
7.833	32.960	60.000	-27.040	26.790	50.000	-23.210	9.700	0.260
7.874	32.960	60.000	-27.040	26.790	50.000	-23.210	9.700	0.260
20.541	37.700	60.000	-22.300	28.490	50.000	-21.510	9.960	0.210
23.203	47.800	60.000	-12.200	37.880	50.000	-12.120	9.930	0.240

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

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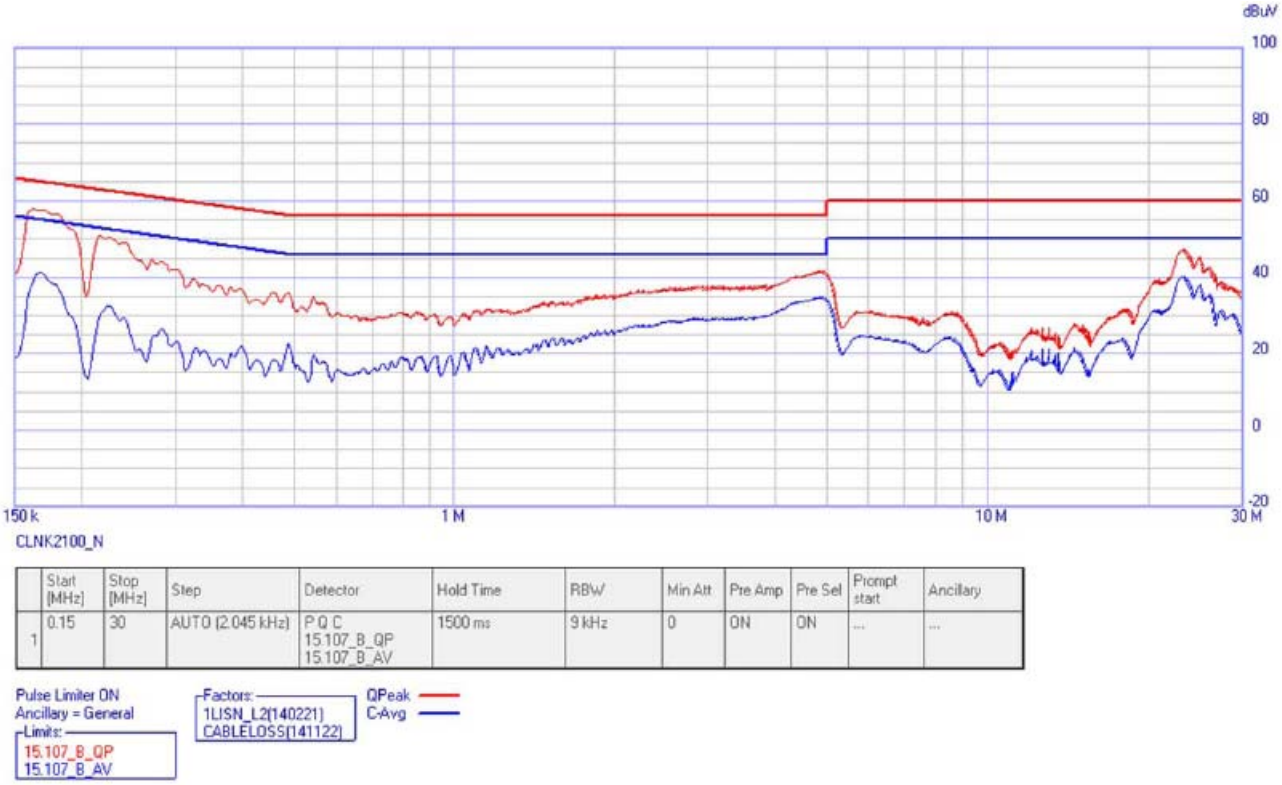

Frequency [MHz]	Q-Peak [dBμV]	Limit [dBμV]	Margin [dB]	C-Avg [dBμV]	Limit [dBμV]	Margin [dB]	Factor (LISN) [dB]	Factor (Cable Loss) [dB]
0.152	42.250	65.890	-23.640	19.690	55.890	-36.200	9.660	0.020
0.162	57.950	65.350	-7.400	39.070	55.350	-16.280	9.660	0.030
0.215	50.690	62.990	-12.300	29.520	52.990	-23.470	9.660	0.030
0.545	34.770	56.000	-21.230	19.560	46.000	-26.440	9.650	0.030
0.547	34.770	56.000	-21.230	19.560	46.000	-26.440	9.650	0.030
2.404	36.770	56.000	-19.230	27.960	46.000	-18.040	9.660	0.090
4.862	41.630	56.000	-14.370	34.720	46.000	-11.280	9.670	0.170
20.870	39.370	60.000	-20.630	30.920	50.000	-19.080	9.820	0.210
23.081	47.460	60.000	-12.540	40.300	50.000	-9.700	9.840	0.230

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

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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	HP	8449B	3008A00538	1 year	2015.07.23
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	RV518	HTK991NC600207R

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Appendix B. Test setup photo

Radiated Emission (30MHz~1GHz)

Radiated Emission (Above 1GHz)

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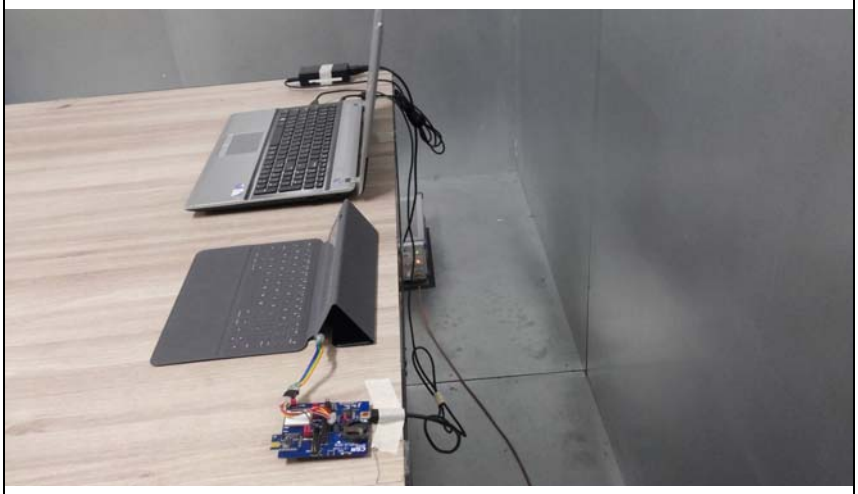
AC conducted Emission



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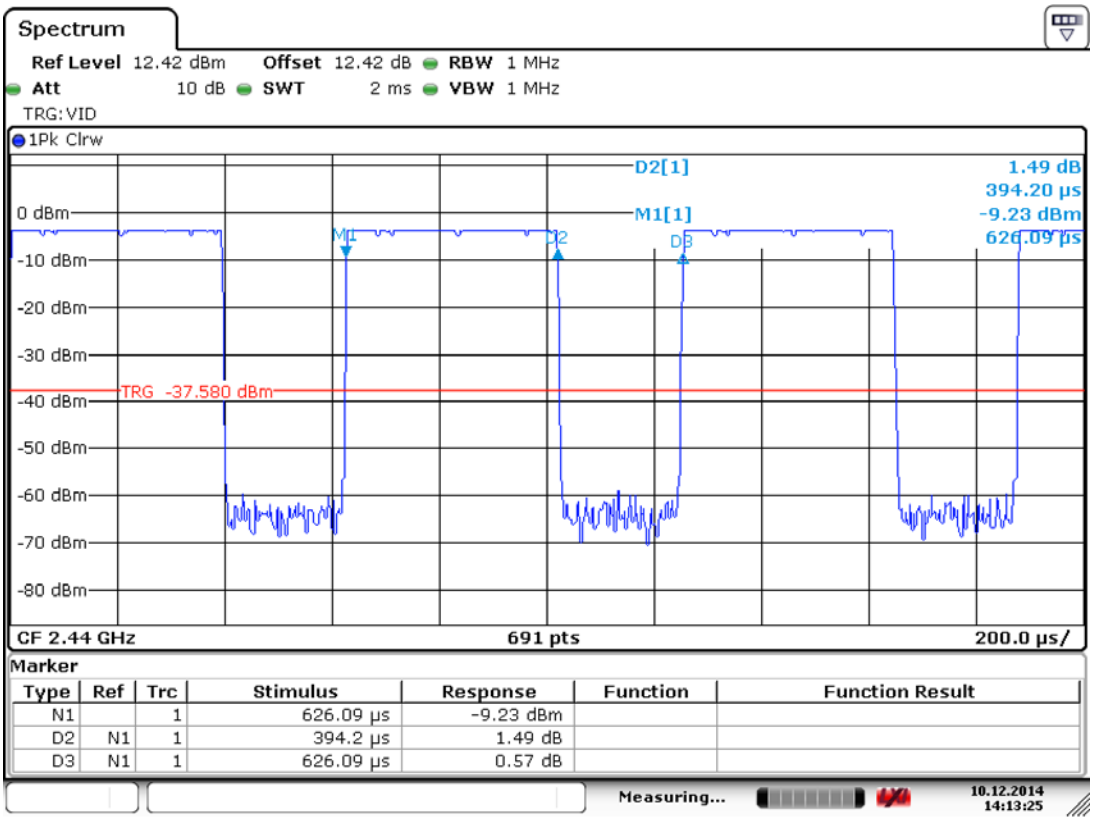
Appendix C. Duty Cycle

Frequency (㎒)	Mode	Duty cycle(X) = Tx_{on} time / (Tx_{on} time + Tx_{off} time)		
		Tx_{on} time (㎳)	Tx_{on} time + Tx_{off} time (㎳)	X
2 440	LE	0.394	0.626	0.629



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