TEST REPORT

Part 15 Subpart C 15.247

Equipment under test UBICHECK(Transmitter)

Model name UBC-GCM-100

FCC ID 2AFWLUBC-GCM-100

Applicant Nextronics Co.,Ltd.

Manufacturer Nextronics Co.,Ltd.

Date of test(s) 2015.09.01 ~2015.10.10

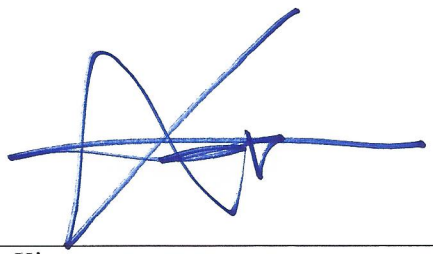
Date of issue 2015.10.12

Issued to

Nextronics Co.,Ltd.
Han-shin IT Tower #505, 272, Digital-ro, Seoul, Korea
Tel: +82-2-2108-6170 / Fax: +82-2-2108-6175

Issued by

KES Co., Ltd.
C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si,
Gyeonggi-do,14057, Korea
473-29, Gayeo-ro, Yeoju-si, Gyeonggi-do, 12658, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450

Test and report completed by :	Report approval by :
	
Kwon-se Kim Test engineer	Jeff Do Technical manager

Revision history

Revision	Date of issue	Test report No.	Description
-	2015.10.12	KES-RF-15T0077	Initial

TABLE OF CONTENTS

1. General information

Applicant: Nextronics Co.,Ltd.

Applicant address: Han-shin IT Tower #505, 272, Digital-ro, Seoul Korea

Test site: KES Co., Ltd.

Test site address: C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do,14057, Korea
473-29, Gayeo-ro, Yeoju-si, Gyeonggi-do, 12658, Korea

Rule part(s): Part 15.247

Test device serial No.: ☐ Production ☒ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test UBICHECK(Transmitter)

Frequency range 2405 ㎒ ~ 2475 ㎒

Model: UBC-GCM-100

Modulation technique DSSS

Number of channels 16

Antenna specification PCB antenna & 4.94 ㏈i

Power source Internal Li-po Battery (DC 3.7 V)

1.2. Frequency/channel operations

Mode	Ch.	Frequency (㎒)
Zigbee	11	2 405
	. .	. .
	18	2 440
	. .	. .
	26	2 475

2. Summary of tests

Reference	Parameter	Test results
15.205 15.209	Radiated spurious emission and band edge	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

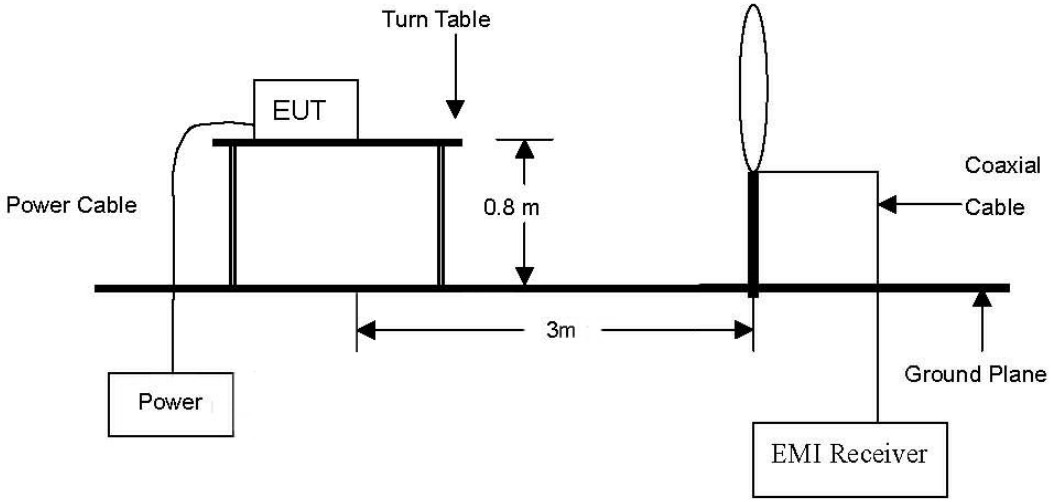
Test procedures;
The EUT was tested per the guidance of ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions testing, the guidance provided in KDB 558074_v03r03 were used in the measurement of the EUT.

3. Test results

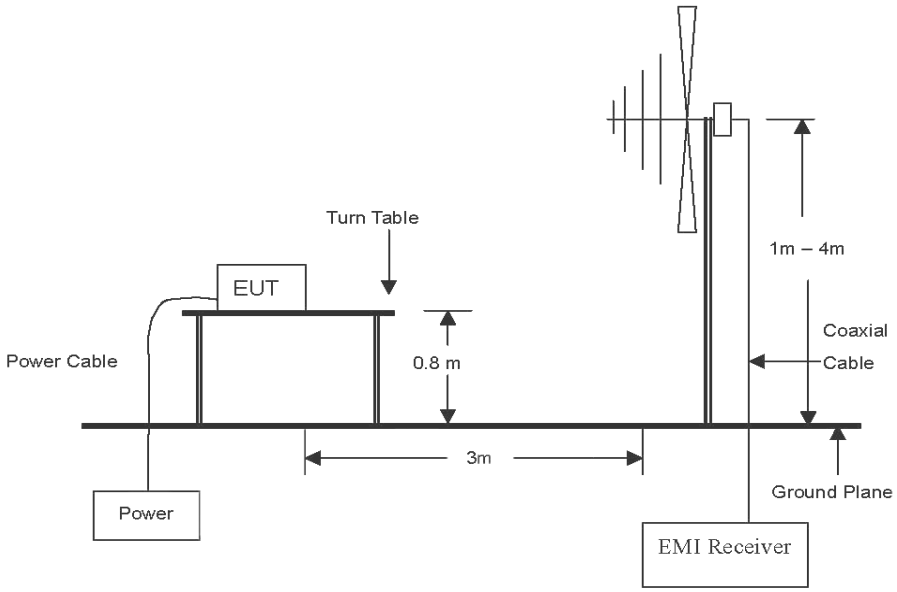
3.1 Radiated spurious emissions & band edge

Test setup

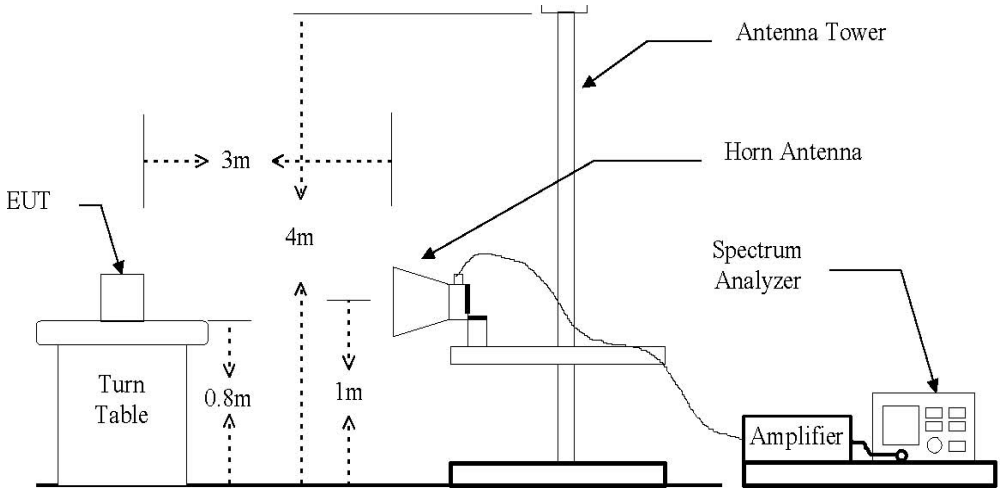
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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 11.0 & 12.0 of KDB 558074_v03r03 and ANSI C63.10-2009

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.

1. Average Field Strength Measurements per Section 12.2.5.1

Analyzer center frequency was set to the frequency of the radiated spurious emission of interest.
Set RBW = 1 ㎒.
Set VBW = 3 ㎒ (≥ 3 x RBW).
Set detector = power average(RMS).
Set sweep time = auto.
Trace (RMS) averaging was performed over at least 100 traces.

2. Peak Field Strength Measurements per Section 12.2.4

Analyzer center frequency was set to the frequency of the radiated spurious emission of interest.
Set RBW = 1 ㎒.
Set VBW = 3 ㎒ (≥ 3 x RBW).
Set detector = Peak.
Set sweep time = auto.
Trace mode = max hold.
Allow sweeps to continue until the trace stabilizes.

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 ㎒)

Channel: 11 / Zigbee

Operating frequency: 2405 ㎒ (Worst case)

Distance of measurement: 3 meter

Frequency (㎒)	Level (dB㎶)	Ant. Pol.	Correction factors (dB/m)	F_d (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
No emission has been detected							

Test results (Below 1 000 ㎒)

Channel: 11 / Zigbee

Operating frequency: 2 405 ㎒ (Worst case)

Distance of measurement: 3 meter

Frequency (㎒)	Level (dB㎶)	Ant. Pol.	Correction factors (dB/m)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
40.670	17.84	V	10.65	28.49	40.00	-11.51
272.500	11.33	V	14.12	25.45	46.00	-20.55
332.640	11.63	H	15.82	27.45	46.00	-18.55
411.210	12.10	V	17.71	29.81	46.00	-16.19
459.710	13.36	H	18.88	32.24	46.00	-13.76
495.600	13.56	H	19.73	33.29	46.00	-12.71
655.650	13.56	V	23.04	36.60	46.00	-9.40
589.690	12.90	H	22.19	35.09	46.00	-10.91

Note.

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

Test results (Above 1 000 ㎒)

Low channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2399.73	68.46	Peak	H	29.13	-30.03	67.56	74.00	6.44
2399.81	52.17	Avg	H	29.13	-30.03	51.27	54.00	2.73
2399.73	58.34	Peak	V	29.13	-30.03	57.44	74.00	16.56
2399.72	47.78	Avg	V	29.13	-30.03	46.88	54.00	7.12
4808.00	39.57	Peak	H	33.80	-25.70	47.67	74.00	26.33
4808.00	40.40	Peak	V	33.80	-25.70	48.50	74.00	25.50

Middle channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
4879.00	39.66	Peak	H	34.14	-25.54	48.27	74.00	25.73
4879.00	40.74	Peak	V	34.14	-25.54	49.35	74.00	24.65

High channel

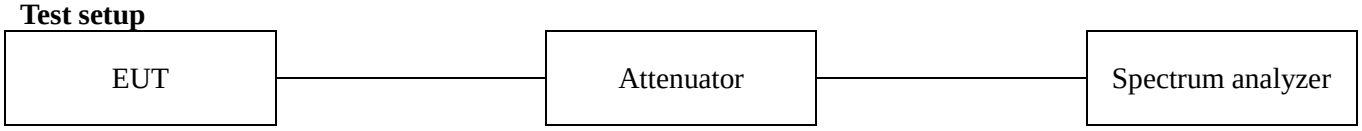
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2483.74	58.80	Peak	H	29.39	-29.84	58.35	74.00	15.65
2483.74	49.09	Avg	H	29.39	-29.84	48.64	54.00	5.36
2483.93	50.81	Peak	V	29.39	-29.84	50.36	74.00	23.64
4950.00	40.24	Peak	H	34.48	-25.37	49.35	74.00	24.65
4950.00	42.61	Peak	V	34.48	-25.37	51.72	74.00	22.28

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 + 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.

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_v03r03, section 11.2&11.3,

1. Use the following spectrum analyzer setting
   Center frequency: Low and high channel.
   Set the span to encompass frequency range to be measured.
   Set the RBW = 100 ㎑.
   Set the VBW = 300 ㎑ (≥3x RBW).
   Detector = peak.
   Sweep time = auto couple.
   Trace mode= max hold.
   Allow trace to fully stabilize.
   Use the peak market function to determine the maximum PSD level.

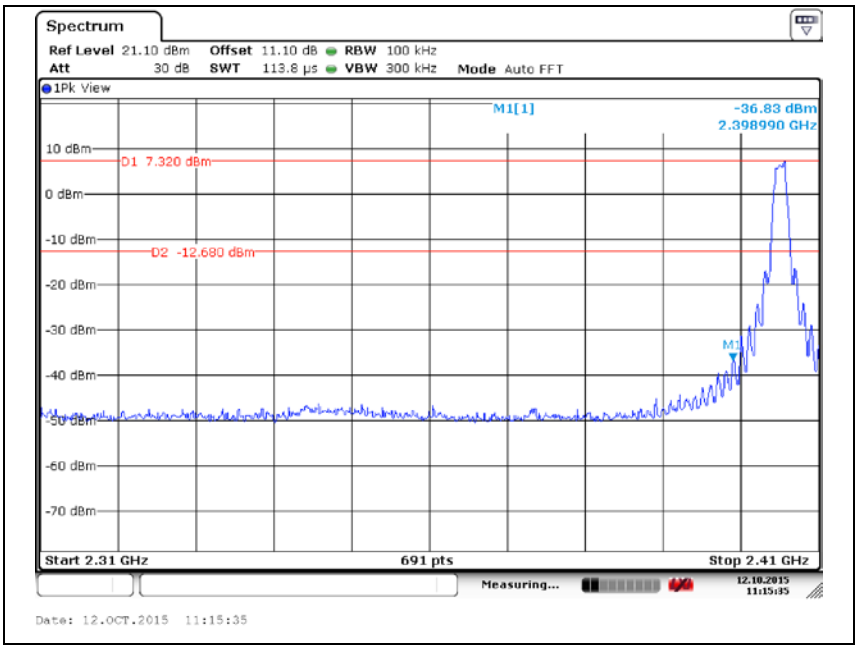
2. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

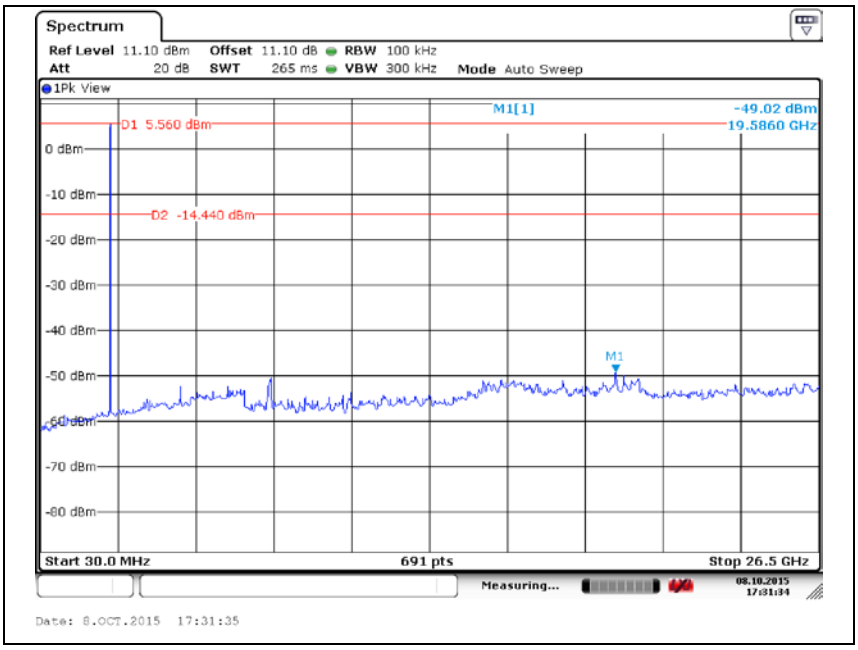
Limit

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 for conducted spurious emission

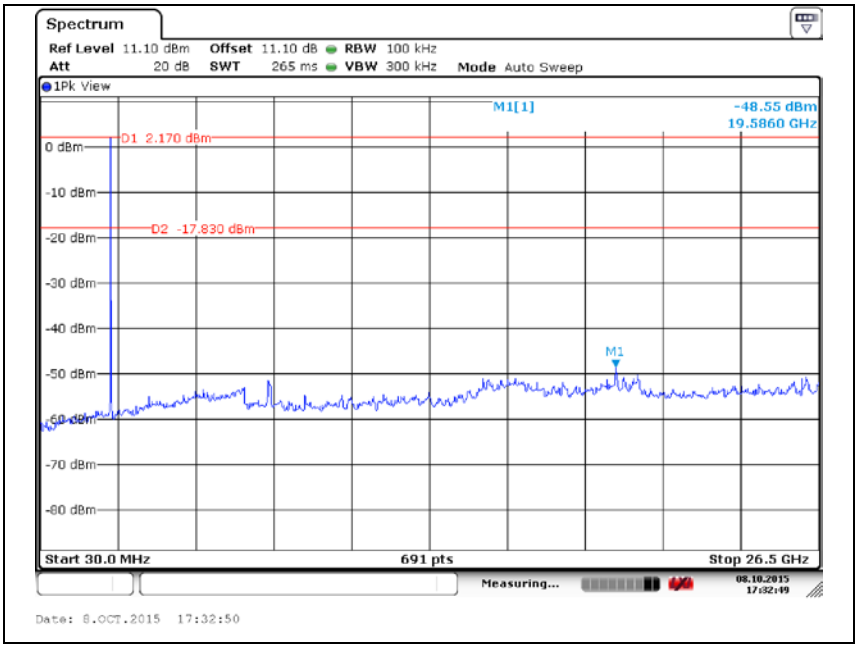
Low channel



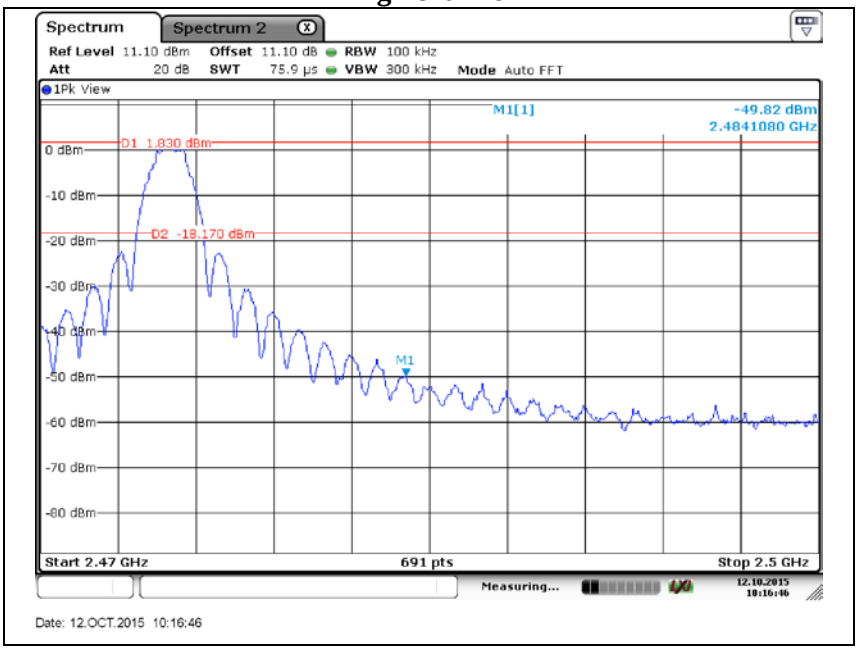


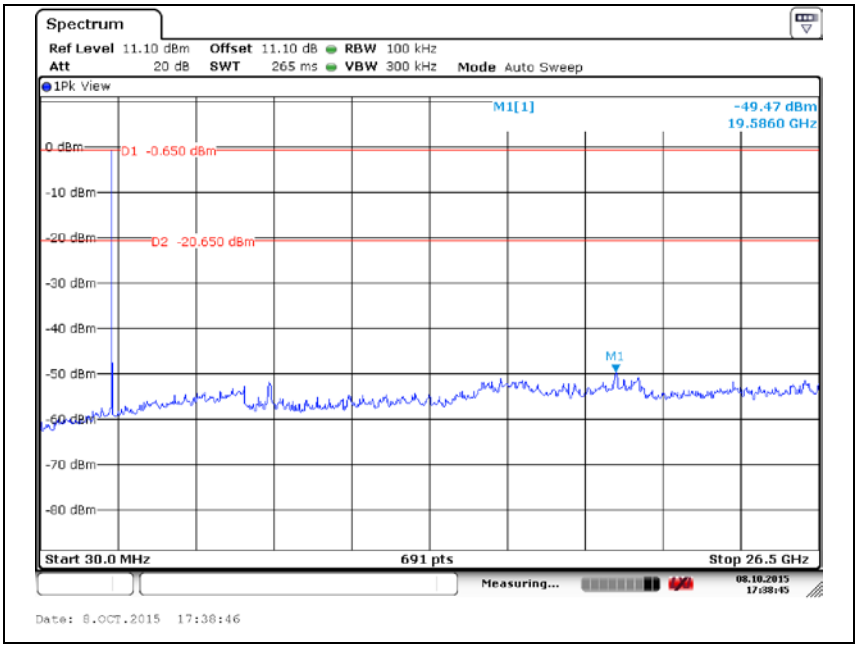
Middle channel

N/A



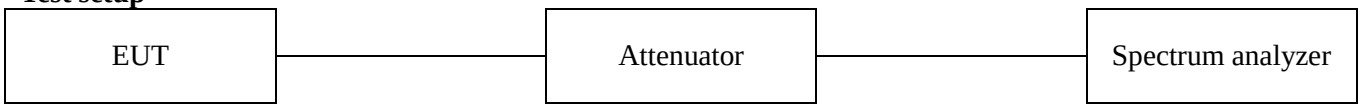
High channel





3.3. 6 dB bandwidth

Test setup



Test procedure

KDB 558074_v03r03 – section 8.1 option 1 or section 8.2 option 2.

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.

Option 2:

The automatic bandwidth measurement capability of an instrument may be employed using the X bandwidth mode with X set to 6 ㏈, if the functionality described above (i.e., RBW = 100 ㎑, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 ㏈.

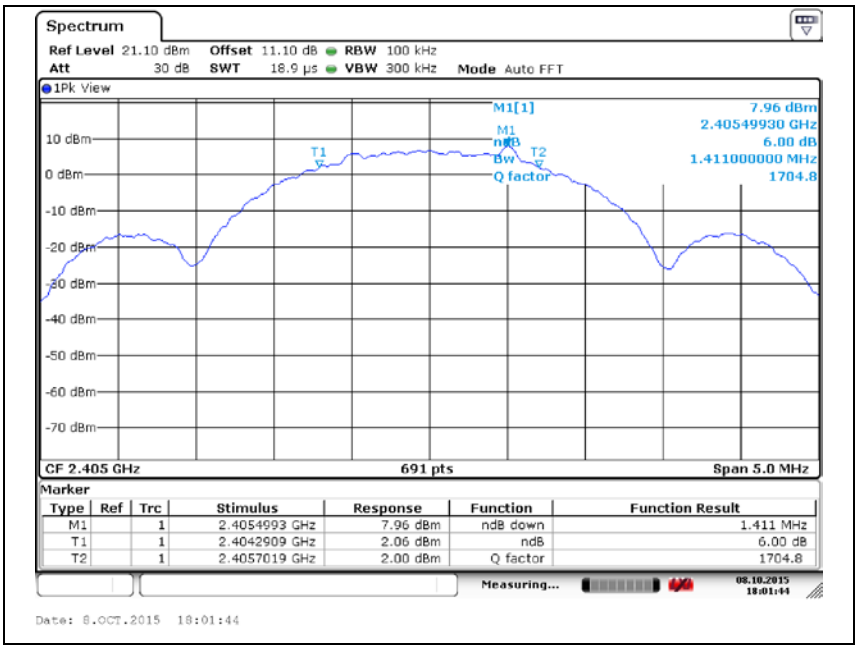
Limit

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 ㎑.

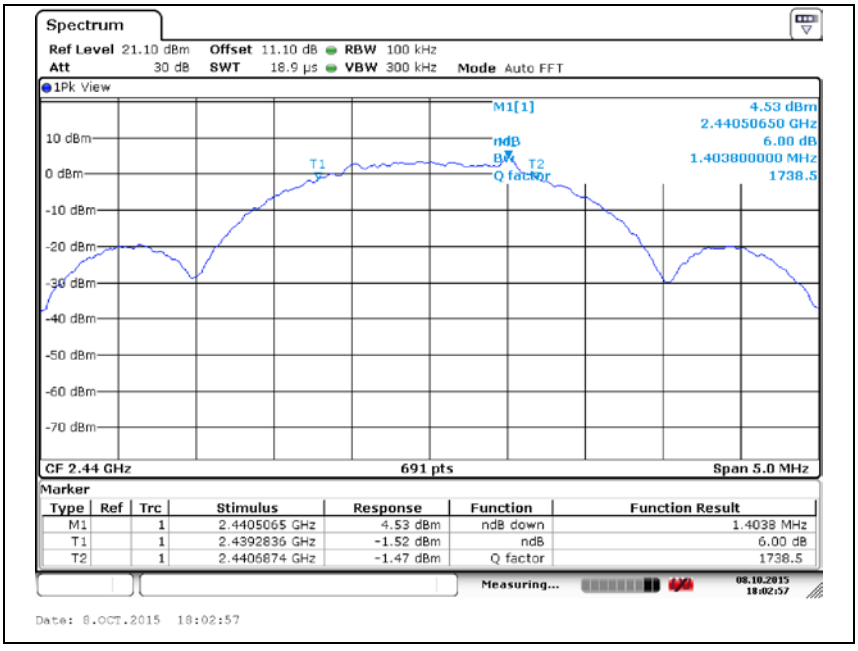
Test results

Operation mode	Frequency(㎒)	6 ㏈ bandwidth(㎒)	Limit(㎒)
Zigbee	2 405	1.41	0.5
	2 440	1.40	
	2 475	1.43	

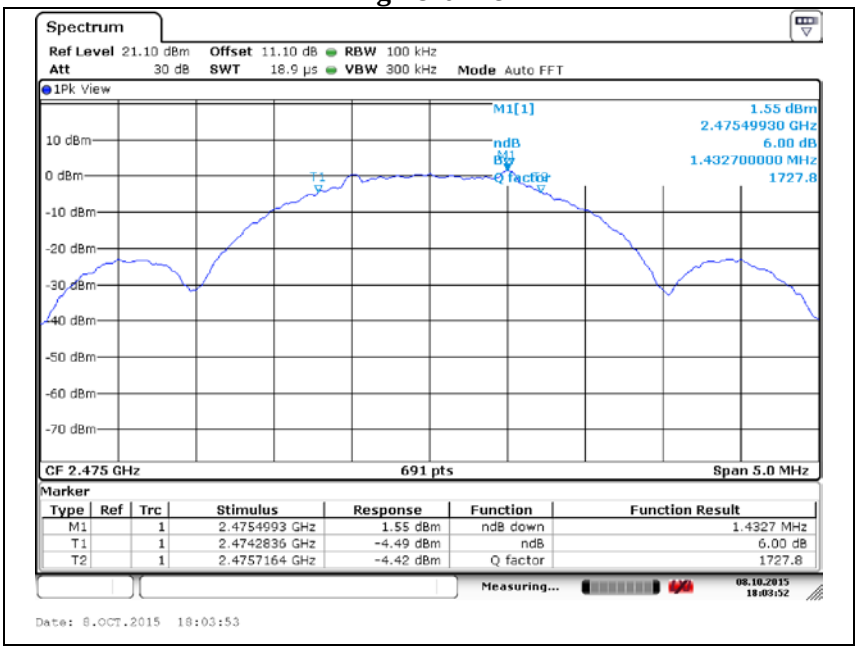
Low channel



Middle channel

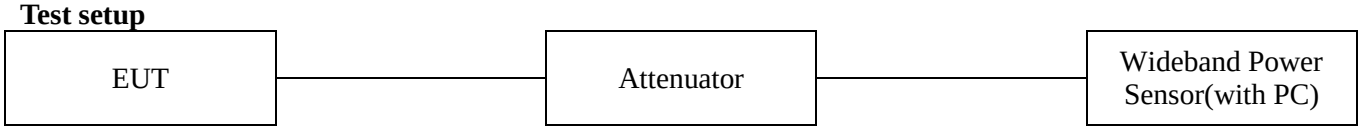


High channel



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_v03r03 – section 9.1.2
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

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(㎒)	Results (dBm)	Limit(dBm)
Zigbee	2 405	9.01	30
	2 440	5.96	
	2 475	2.96	

3.5. Power spectral density

Test setup

Test procedure

KDB 558074_v03r03– 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 to: 3 kHz ≤ RBW ≤ 100 kHz.
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 within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

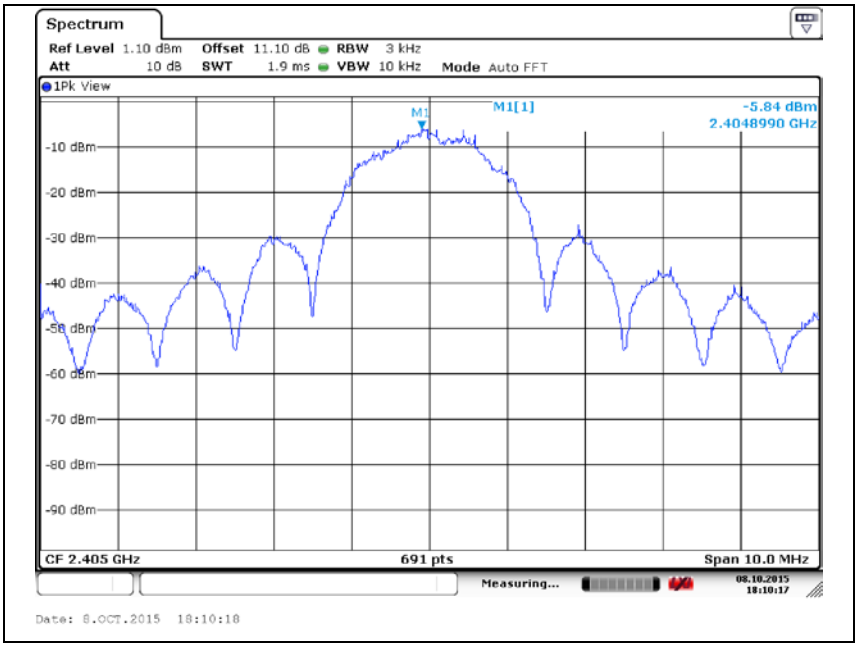
Limit

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.

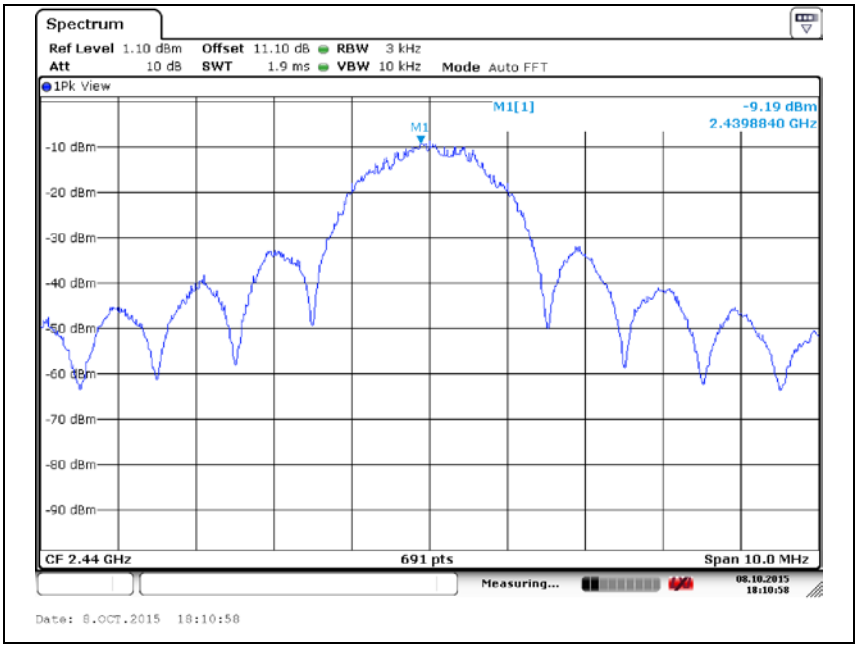
Test results

Operation mode	Frequency(㎒)	Measured PSD(㏈m)	Limit(㏈m)
Zigbee	2 405	-5.84	8
	2 440	-9.19	
	2 475	-11.70	

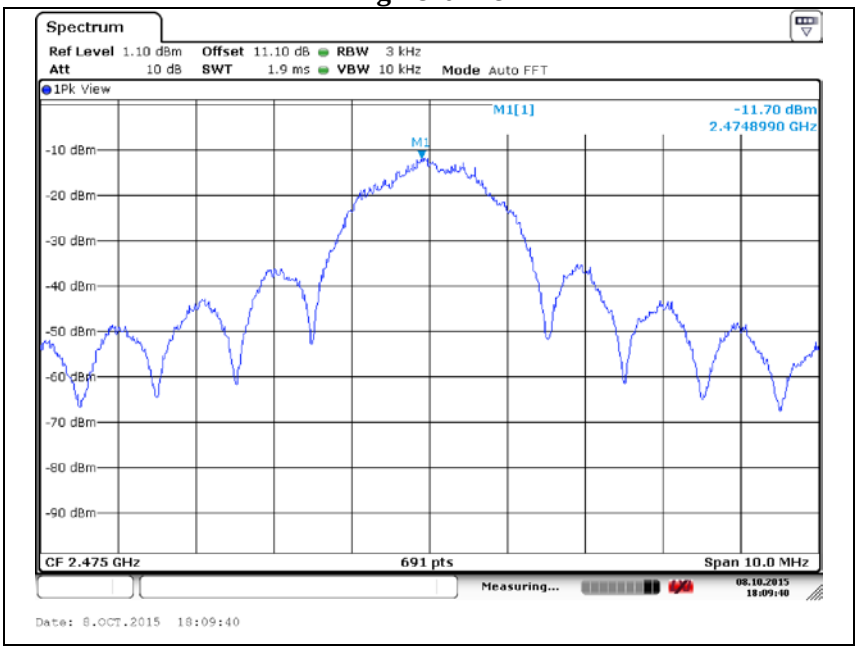
Low channel



Middle channel



High channel



Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV40	101002	1 year	2016.07.25
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2016.01.23
Attenuator	HP	8493C	78799	1 year	2016.07.24
Power Meter	Anritsu	ML2495A	1438001	1 year	2016.01.22
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2016.01.26
Loop Antenna	R&S	HFH2-Z2.335.4711.52	826532	2 years	2017.03.03
Trilog-broadband antenna	Schwarzbeck	VULB 9163	9168-713	2 years	2017.05.15
Horn antenna	A.H.	SAS-571	781	2 years	2017.05.07
High Pass Filter	WAINWRIGHT INSTRUMENT	WHJS3000-10TT	1	1 year	2016.07.24
Low Pass Filter	WEINSCHEL	WLK1.0/18G-10TT	1	1 year	2016.07.24
Preamplifier	HP	8447F	2805A02570	1 year	2016.01.23
Brodband preamplifier	Schwarzbeck	BBV9718	9718-246	1 years	2015.10.23
EMI Test Receiver	R&S	ESR3	101781	1 year	2016.05.06
DC Power supply	SMtechno	SDP 30-5D	305DKJ119	1 year	2016.04.01
DC Power supply	SORENSEN	DCS40-75E	1408A02745	1 year	16.01.22

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
-	-	-	-