TEST REPORT

FCC Part 15.247

Equipment under test	Wireless Baby Monitor
Model name	SEW-3042WN
FCC ID	NLMSEW3042WN
Applicant	Hanwha Techwin Co., Ltd.
Manufacturer	Tianjin Samsung Electronics Co., Ltd.
Date of test(s)	2016.01.11 ~ 2016.01.25
Date of issue	2016.01.27

Issued to

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Revision history

Revision	Date of issue	Test report No.	Description
-	2016.01.20	KES-RF-16T0008	Initial
1	2016.01.27	KES-RF-16T0008-R1	Retest a output power and a number of hopping frequency

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1. General information

Applicant:	Hanwha Techwin Co., Ltd.
Applicant address:	1204, Changwon-daero, Seongsan-gu, Changwon-si Gyeongsangnam-do, South Korea
Test site:	KES Co., Ltd.
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FCC rule part(s):	15.247
Test device serial No.:	☒ Production ☐ Pre-production ☐ Engineering
Application purpose:	☒ Original grant ☐ Class I permissive change ☐ Class II permissive change

1.1. EUT description

Equipment under test	Wireless Baby Monitor
Frequency range	2408 ㎒ ~ 2468 ㎒
Model	SEW-3042WN
Modulation technique	FHSS
Type of Modulation	GFSK
Number of channels	16
Antenna specification	Antenna type: Dipole Peak gain: 2 ㏈i
Power source	DC 3.8 V (Rechargeable Battery)

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted

15.247(g): The system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): The system does not coordinate it channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

Pseudorandom frequency hopping sequence
The channel is represented by a pseudo-random hopping sequence hopping through the 16 RF channels.

Equal hopping frequency use
All channels are used equally on average.

Example of a 16 hopping sequence in data mode:
12, 14, 03, 16, 02, 05, 10, 06, 09, 01, 13, 07, 11, 08, 15, 04

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1.2. Test configuration

The Wireless Baby Monitor FCC ID: NLMSEW3042WN was tested per the guidance of ANSI C63.10-2009 and DA 00-705. ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

1.3. Frequency/channel operations

Ch.	Frequency (㎒)
01	2408
. .	. .
09	2440
. .	. .
16	2468

1.4. Information about derivative model

N/A

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2. Summary of tests

Section in FCC Part 15	Test description	Test results
15.205, 15.209	Radiated restricted band and emission	Pass
15.207(d)	Conducted band edge and out of band emissions	Pass
15.247(a)(1)(iii)	20 dB bandwidth	Pass
15.247(b)(1)	Output power	Pass
15.247(a)(1)	Channel separation	Pass
15.247(a)(1)(iii)	Number of channels	Pass
15.247(a)(1)(iii)	Time of occupancy	Pass
15.207	AC conducted emissions	Pass

Note:

1. The EUT was tested per the guidance of DA 00-705. ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions 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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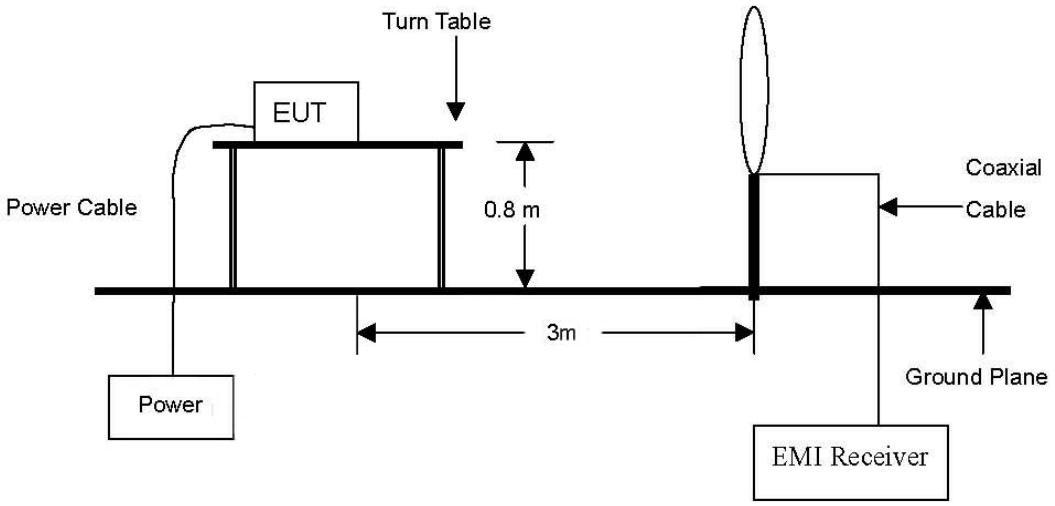
3. Test results

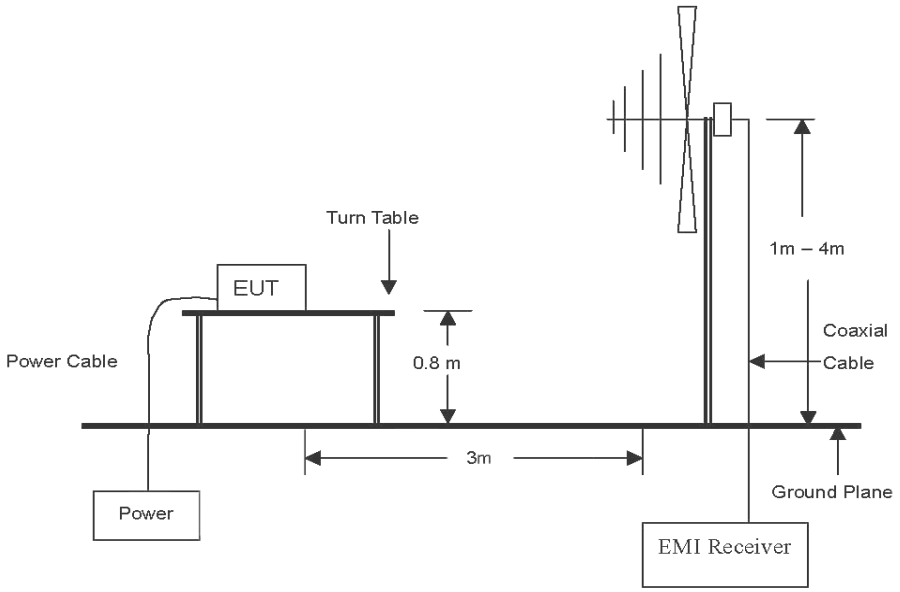
3.1. Radiated restricted band and emissions

Test setup

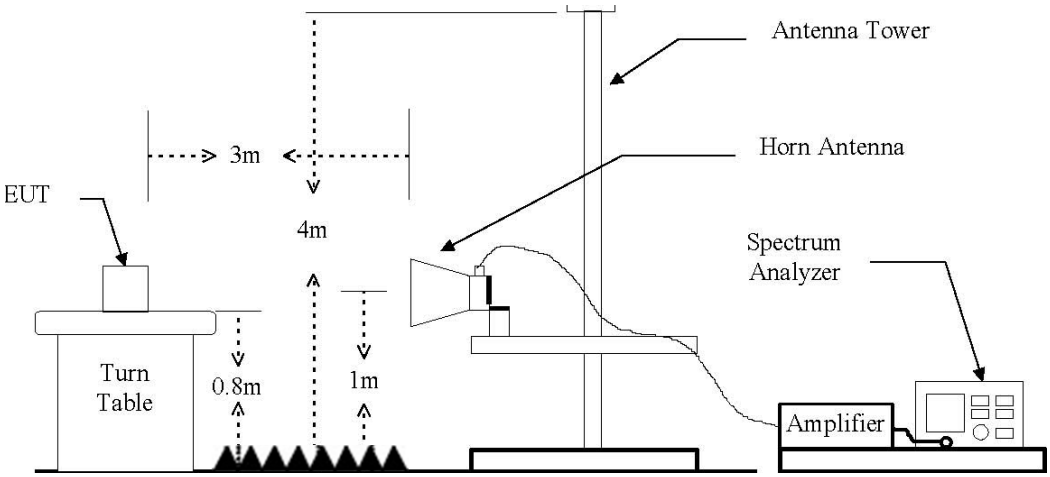
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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.



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Test procedure

1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Spectrum analyzer settings:
   Span = wide enough to fully capture the emission being measured
   RBW = 1 ㎒for f ≥1 GHz, 100 ㎑ for f < 1 ㎓
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
8. Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

Note:

1. 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.
2. When Average result is different from peak result over 20 ㏈ (over-averaging), according to 15.35 (c), as a "duty cycle correction factor", pulse averaging with 20 log(duty cycle) has to be used.
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.
5. Field strength(㏈㎶/m) = Level(㏈㎶) + Correction factors(㏈/m) + Cable loss(㏈) + F_d(㏈)
6. Correction factors(㏈/m) = Antenna factor(㏈/m) + Cable loss(㏈) + or Amp. gain(㏈)
7. Margin(㏈) = Limit(㏈㎶/m) - Field strength(㏈㎶/m)
8. f ≥ 30 ㎒, extrapolation factor of 20 ㏈/decade of distance. Fd = 20log(Dm / Ds)
   f < 30 ㎒, extrapolation factor of 40 ㏈/decade of distance. Fd = 40log(Dm / Ds)
   Where:
   F_d = Distance factor in ㏈
   D_m = Measurement distance in meters
   D_s = Specification distance in meters

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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.

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Test results (Below 30 ㎒)

Mode: GFSK

Distance of measurement: 3 meter

Operating frequency: 2 468 ㎒ (Worst case)

Channel: 16

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

Test results (Below 1 000 ㎒)

Mode: GFSK

Distance of measurement: 3 meter

Operating frequency: 2 468 ㎒ (Worst case)

Channel: 16

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)
216.24	23.12	H	10.74	1.33	35.19	46.00	-10.81
216.24	19.29	V	10.74	1.33	31.36	46.00	-14.64
384.05	22.73	H	15.12	1.78	40.23	46.00	-5.77
432.55	23.21	H	16.80	1.94	41.95	46.00	-4.05
432.55	22.60	V	16.80	1.94	41.34	46.00	-4.66
480.08	24.49	H	17.86	2.09	44.44	46.00	-1.56
480.08	19.12	V	17.86	2.09	39.07	46.00	-6.93

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: GFSK
Distance of measurement: 3 meter
Operating frequency: 2 408 ㎒
Channel: 01

Frequency (㎒)	Level (dBμV)	Detect	Ant. Pol.	Correction factors		Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
				AFCL(dB)	DCF(dB)			
2389.67	53.26	Peak	H	-0.95	-	52.31	74.00	21.69
2389.57	48.15	Peak	V	-0.95	-	47.20	74.00	26.80
4816.00	35.82	Peak	H	8.16	-	43.98	74.00	30.02
4816.00	38.24	Peak	V	8.16	-	46.40	74.00	27.60

Mode: GFSK
Distance of measurement: 3 meter
Operating frequency: 2 440 ㎒
Channel: 09

Frequency (㎒)	Level (dBμV)	Detect	Ant. Pol.	Correction factors		Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
				AFCL(dB)	DCF(dB)			
4880.00	38.93	Peak	H	8.61	-	47.54	74.00	26.46
4880.00	40.15	Peak	V	8.61	-	48.76	74.00	25.24

Mode: GFSK
Distance of measurement: 3 meter
Operating frequency: 2 468 ㎒
Channel: 16

Frequency (㎒)	Level (dBμV)	Detect	Ant. Pol.	Correction factors		Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
				AFCL(dB)	DCF(dB)			
2483.91	58.20	Peak	H	-0.45	-	57.75	74.00	16.25
2483.53	48.01	Avg	H	-0.45	-	47.56	54.00	6.44
2483.64	48.47	Peak	V	-0.45	-	48.02	74.00	25.98
4901.00	37.07	Peak	H	8.76	-	45.83	74.00	28.17
4959.00	36.54	Peak	V	9.18	-	45.72	74.00	28.28

Note.
1. Average test would be performed if the peak result were greater than the average limit.
2. Actual = Reading + AFCL(Ant. factor – Amp. gain + Cable loss) + DCF(Duty cycle correction factor)
3. Duty cycle correction factor = 20log(dwell time/100 ㎳)

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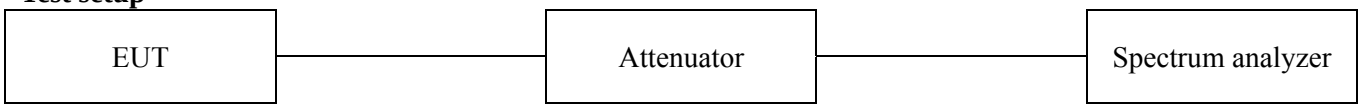
3.2. Conducted band edge and out of band emissions

Test setup



Test procedure
DA 00-705

Test setting
1. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions(e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
2. RBW = 100 ㎑
3. VBW ≥ 300 ㎑
4. Detector = Peak
5. Number of sweep points ≥ 2 × Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. 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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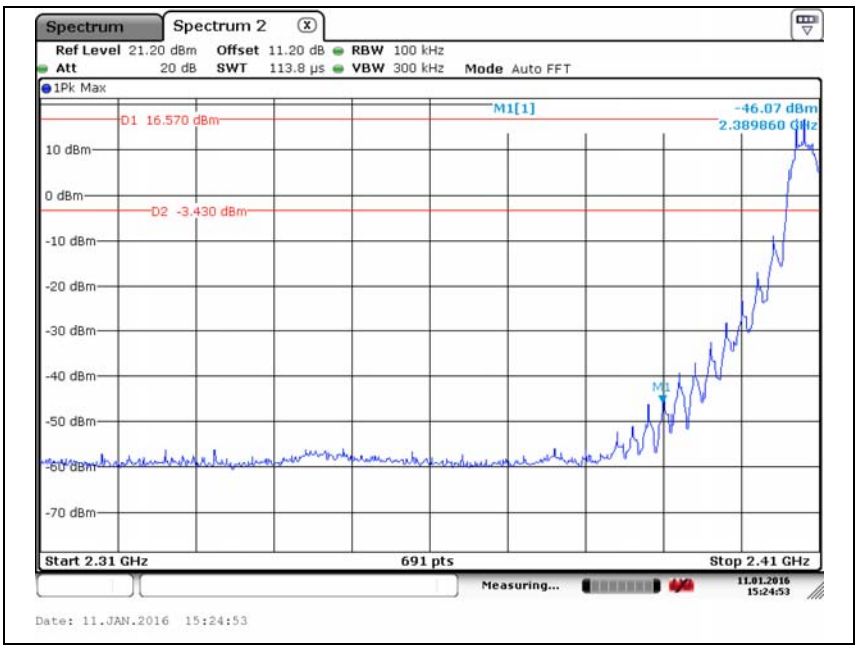
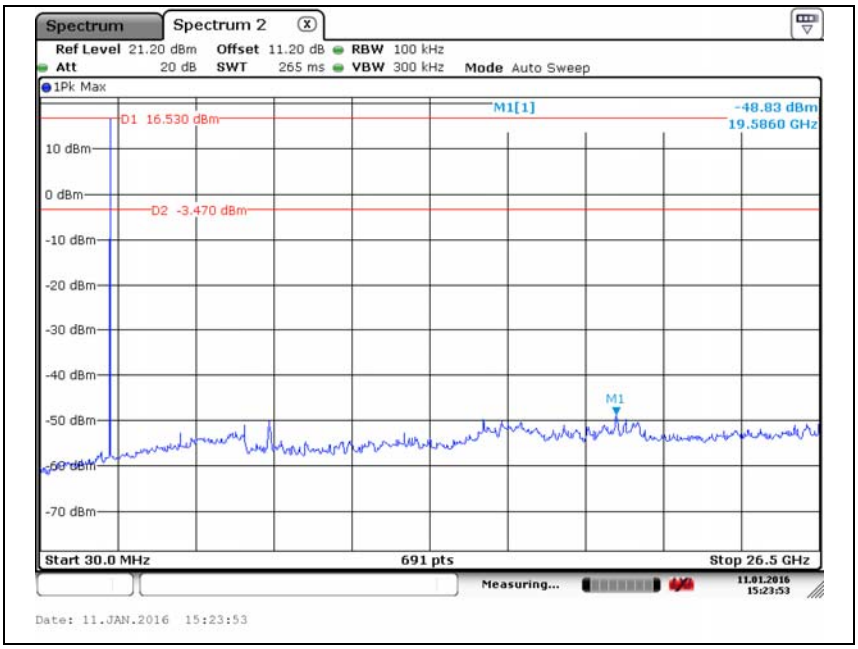
Ch. 01





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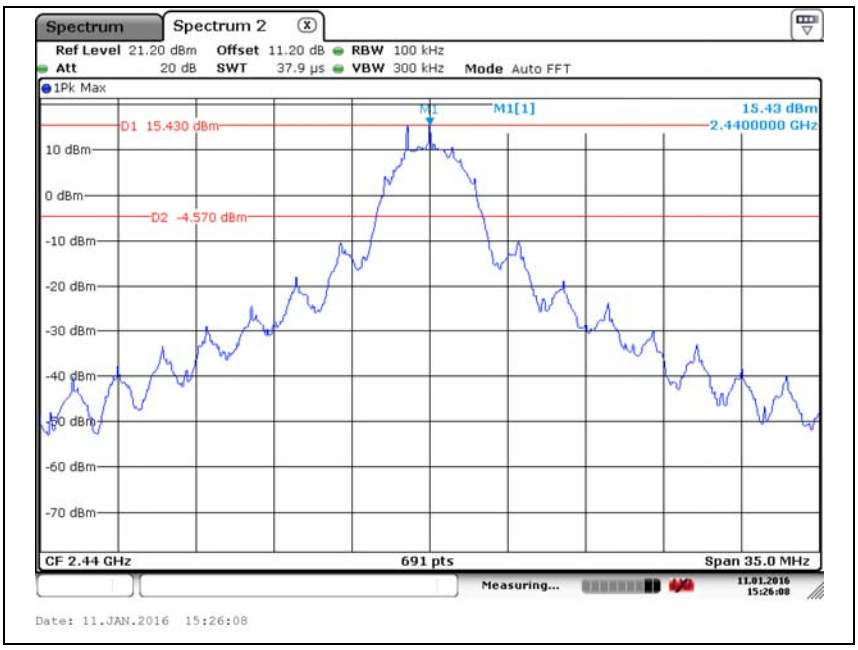
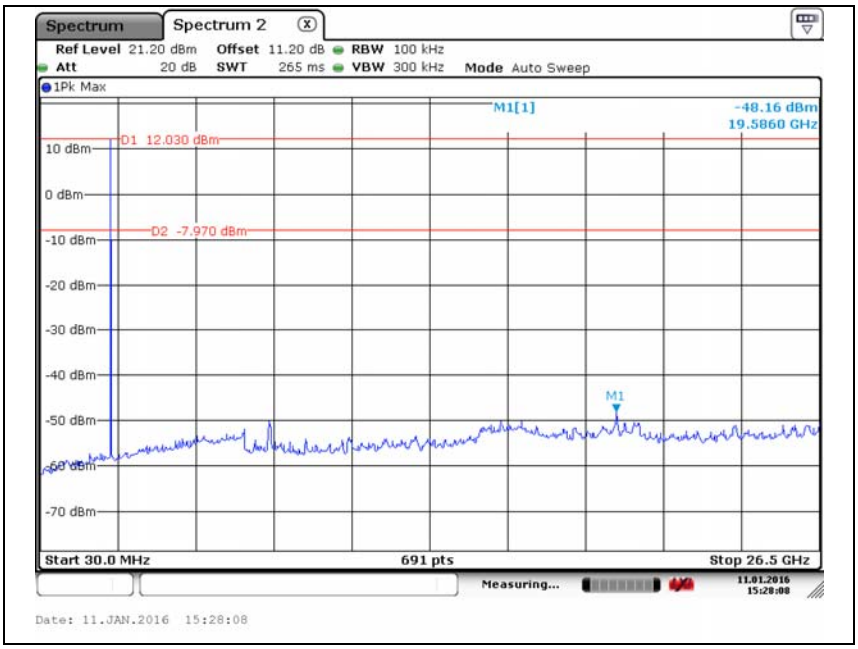
Ch. 09





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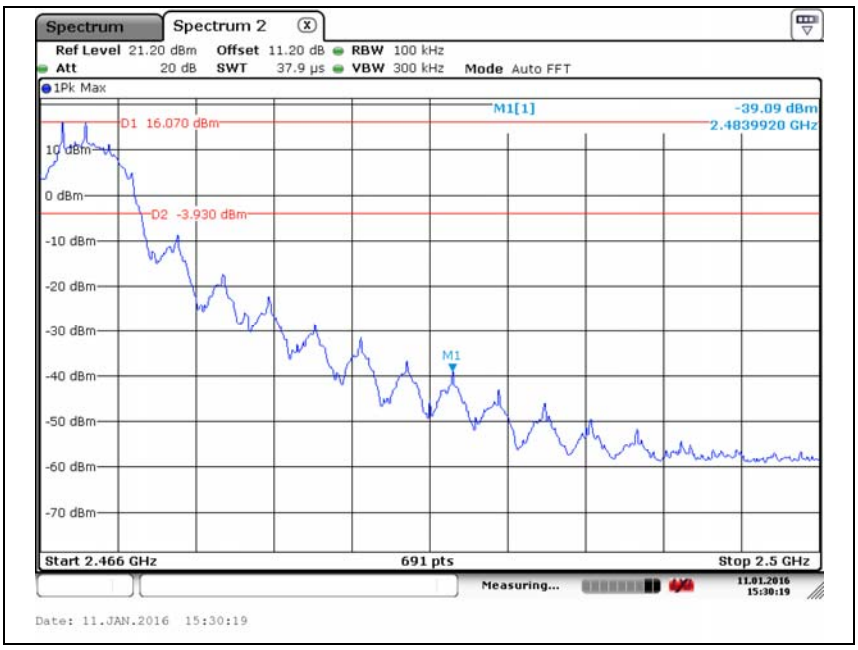
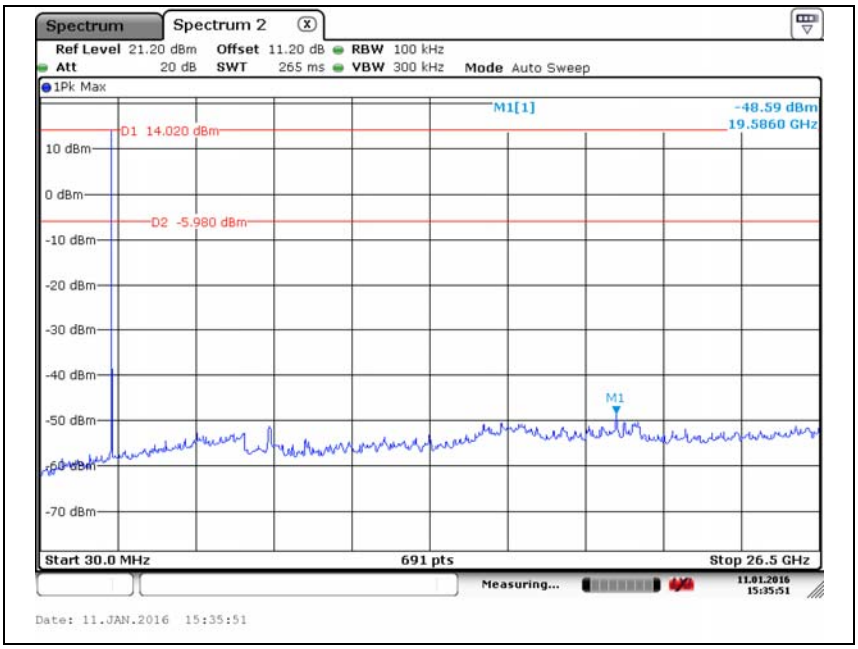
Ch. 16





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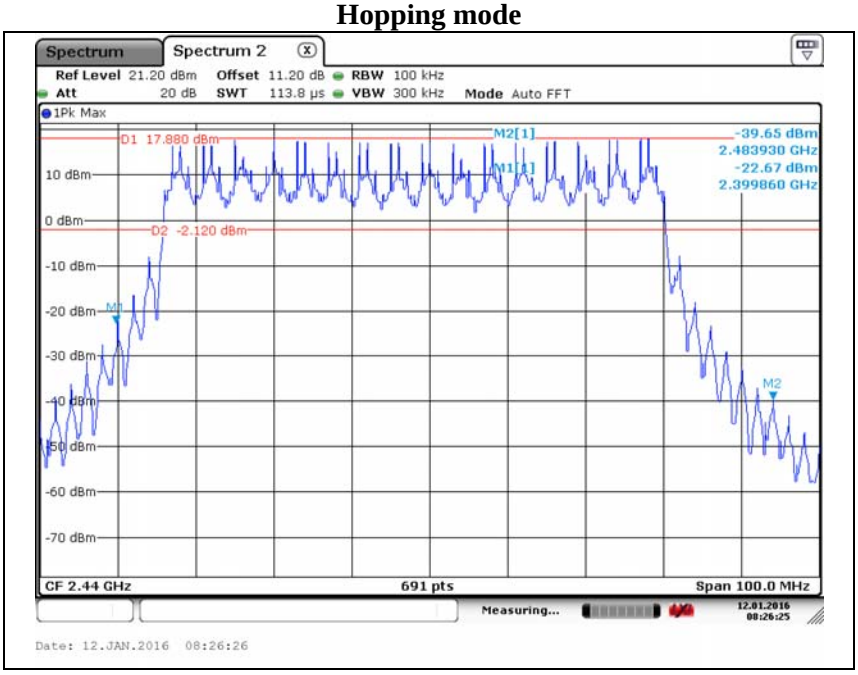
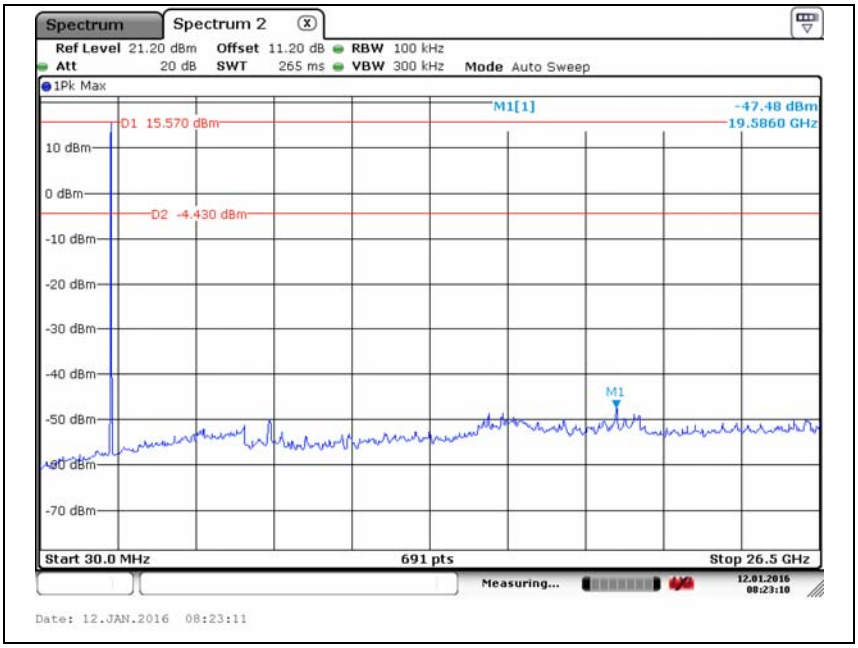
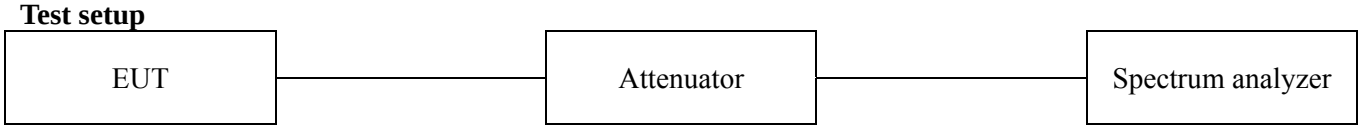
Hopping mode





3.3. 20 dB bandwidth

Test setup



Test procedure
DA 00-705

Test setting
1. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
2. RBW ≥ 1% of the 20 dB bandwidth
3. VBW ≥ RBW
4. Sweep = auto
5. Detector function = peak
6. Sweep = auto couple
7. Trace mode = max hold

Limit
Not applicable

Frequency(㎒)	Channel no.	Measured bandwidth(㎒)
2 408	01	4.110
2 440	09	4.110
2 468	16	3.994

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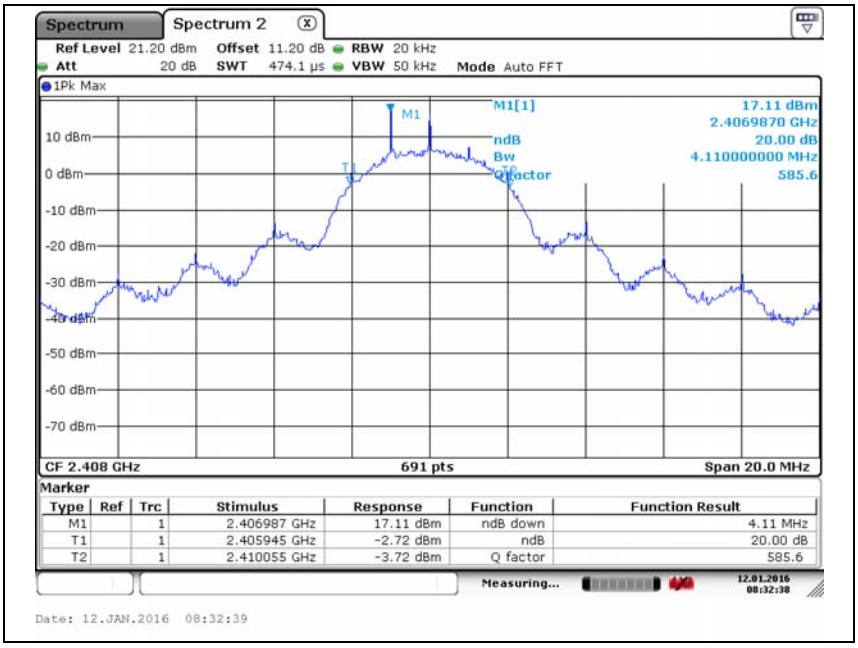
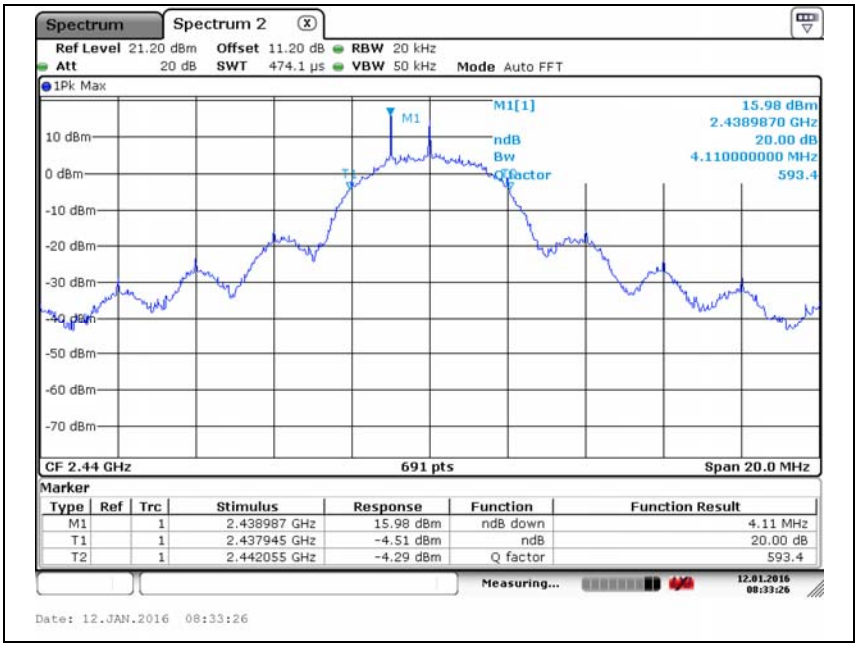
Ch. 01



Ch. 09



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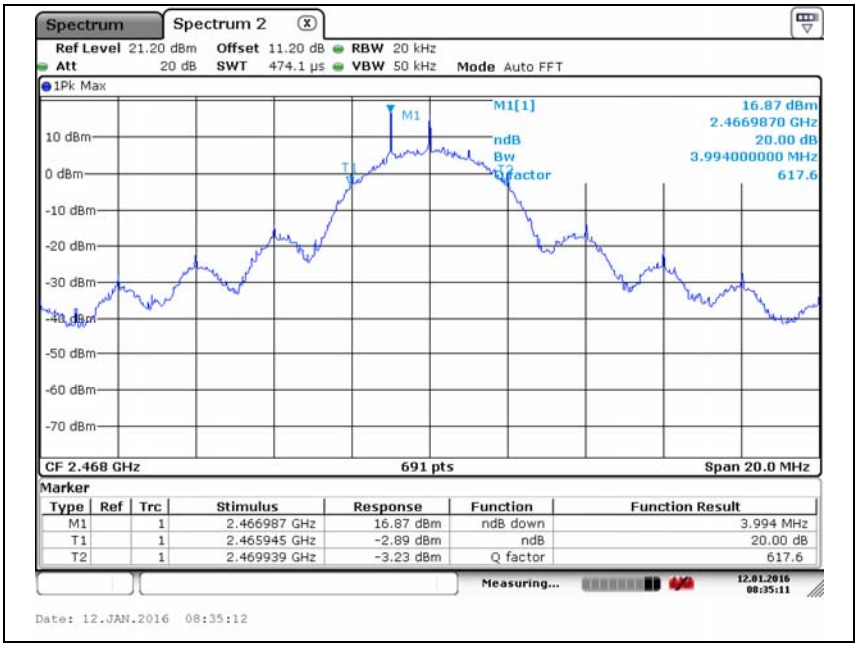
Ch. 16



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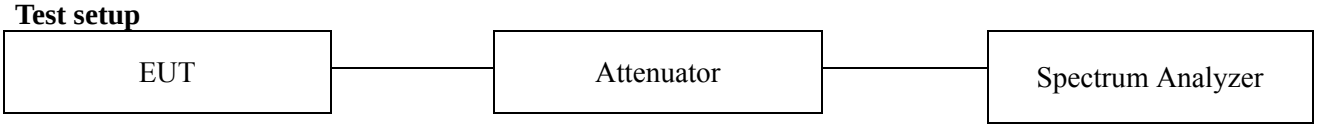
3.4. Output power

Test setup



Test procedure
DA 00-705

Test setting
1. Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
2. RBW > the 20 dB bandwidth of the emission being measured
3. VBW ≥ RBW
4. Sweep = Auto
5. Detector function = Peak
6. Trace = Max hold

Limit
According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

According to §15.247(b)(1), For frequency hopping systems operating in the 2 400 ~ 2 483.5 ㎒ employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 ~ 5 805 ㎒ band: 1 Watt.

Frequency(㎒)	Channel no.	Measured power(㏈m)
2 408	01	16.44
2 440	09	15.36
2 468	16	16.55

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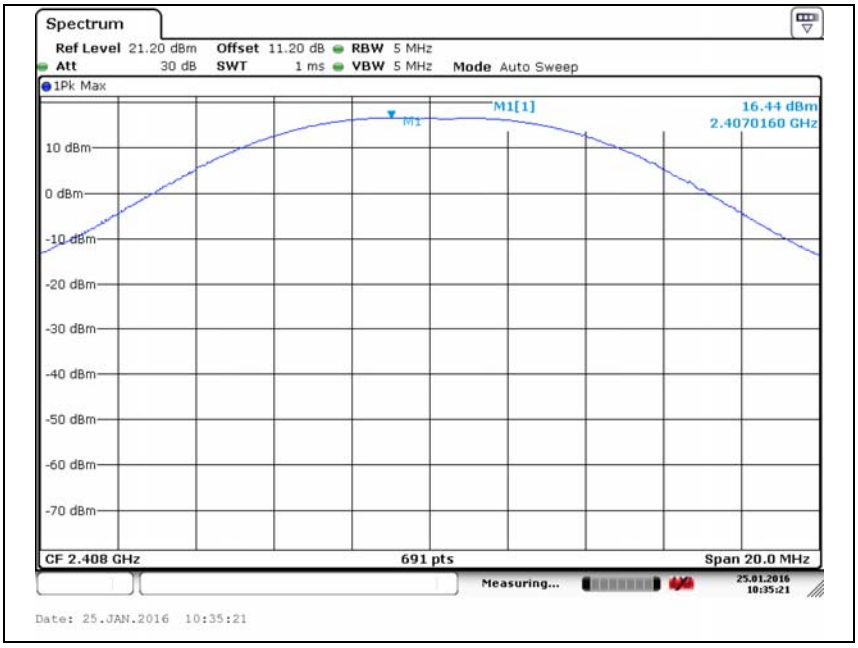
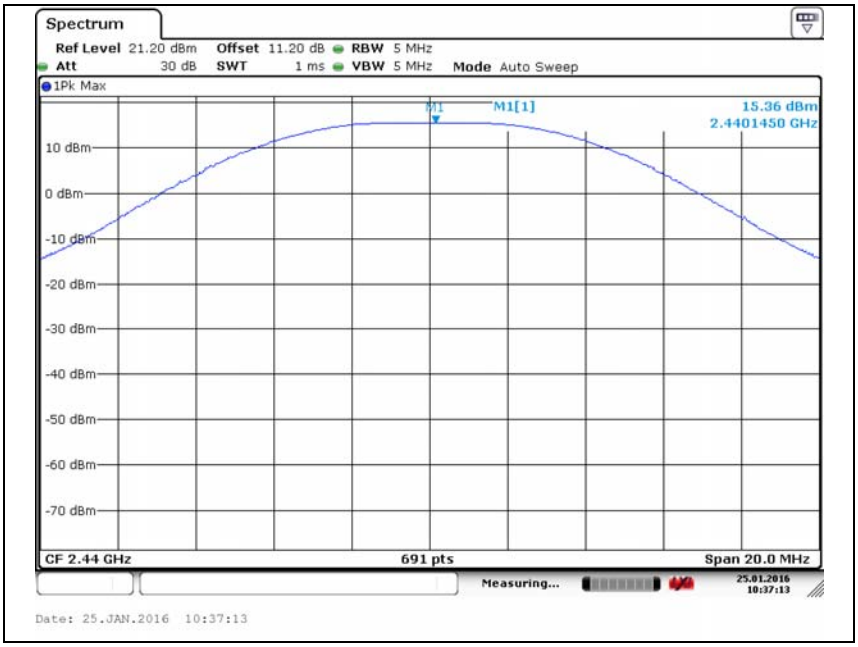
Ch. 01



Ch. 09



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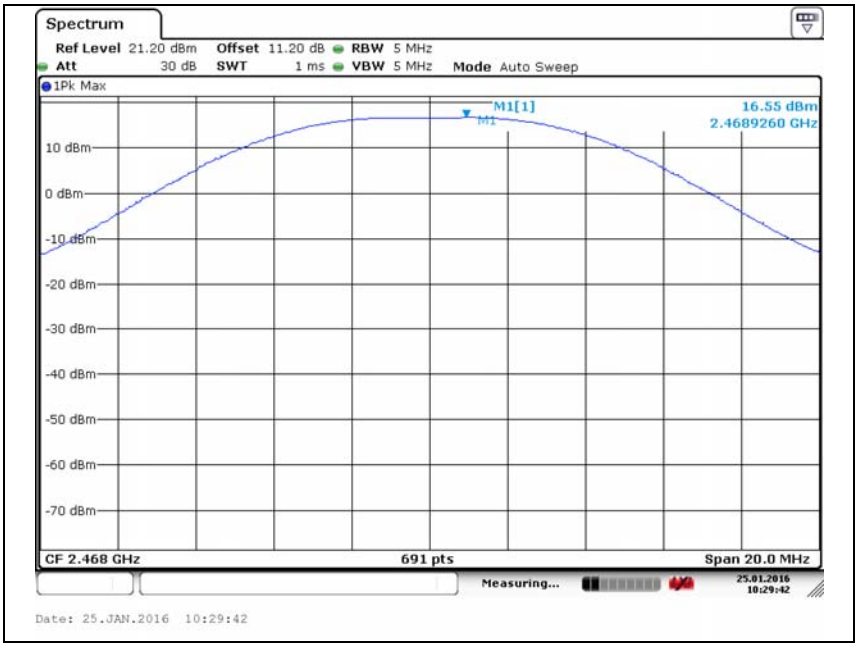
Ch. 16



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3.5. Carrier frequency separation

Test setup

EUT	—	Attenuator	—	Spectrum analyzer

Test procedure

DA 00-705

Test Setting

1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = wide enough to capture the peaks of two adjacent channels
3. Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span
4. Video (or Average) Bandwidth (VBW) ≥ RBW
5. Sweep = auto
6. Detector function = peak
7. Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Limit

According to 15.247(a)(1), frequency hopping system operating in 2 400 ~ 2 483.5 ㎒. Band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-third of 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

Frequency(㎒)	Channel no.	Channel Separation (㎒)
2 440	09	4.009

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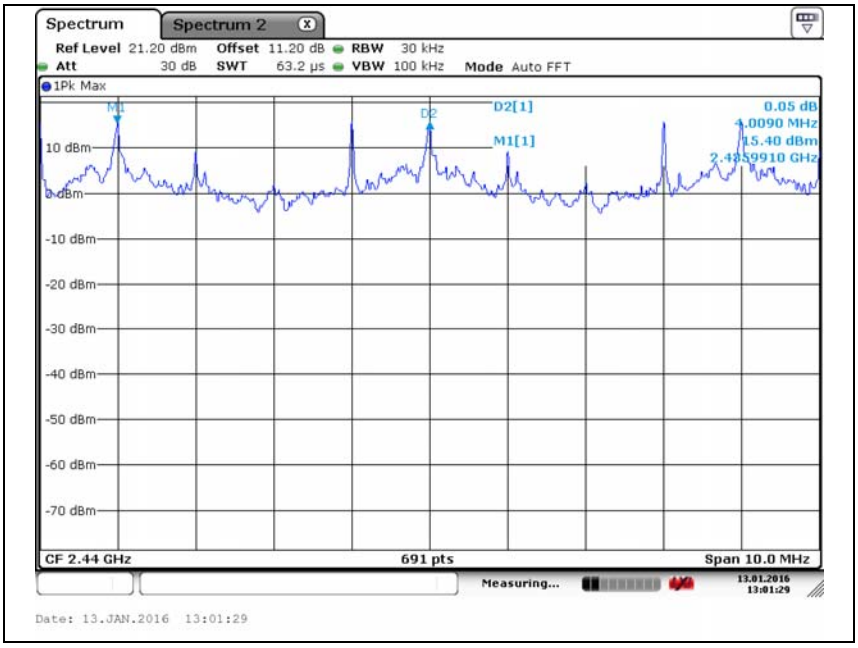
Ch. 09



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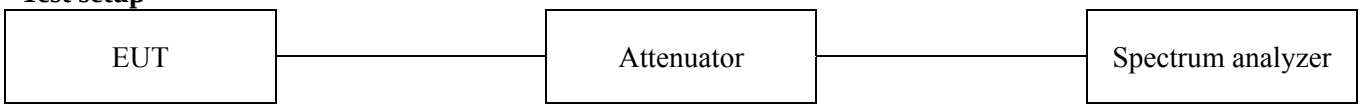
3.6. Number of hopping frequency

Test setup



Test procedure
DA 00-705

Test setting
1. The EUT must have its hopping function enabled.
2. Frequency range: 2 400 ㎒ ~ 2 483.5 ㎒
3. Span = the frequency band of operation
4. RBW = 1 ㎒ (≥ 1% of the span)
5. VBW = 1 ㎒ (≥ RBW)
6. Sweep = auto
7. Detector function = peak
8. Trace = max hold

All the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Limit
According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 ㎒ bands shall use at least 15 hopping frequencies.

Frequency	Number of hopping frequency	Limit
2 408 ~ 2 468 ㎒	16	≥ 15

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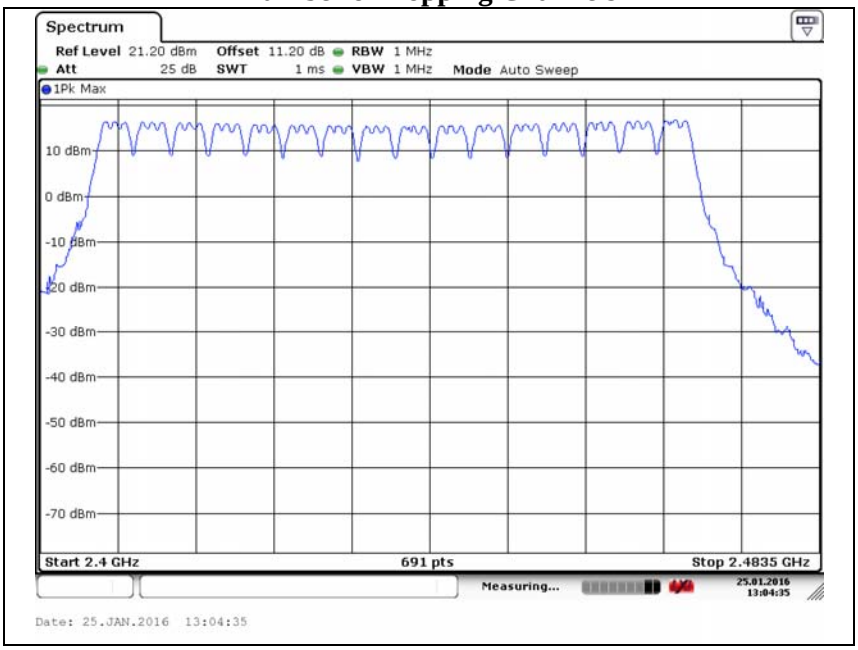
Number of Hopping Channels



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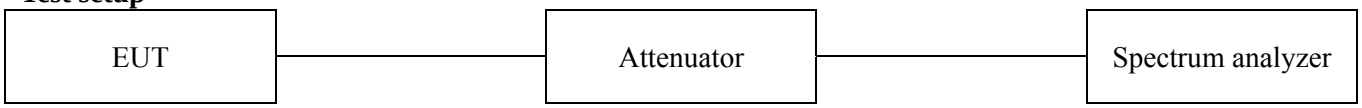
3.7. Time of occupancy

Test setup



Test procedure
DA 00-705

Test setting
1. The EUT must have its hopping function enabled.
2. Span = zero span, centered on a hopping channel
4. RBW = 1 ㎒
5. VBW = 1 ㎒ (≥ RBW)
6. Sweep = as necessary to capture the entire dwell time per hopping channel
7. Detector function = peak
8. Trace = max hold

Limit
According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 ㎒ band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 6.4 second period.

A period time = 0.4(s) × 16 = 6.4(s)

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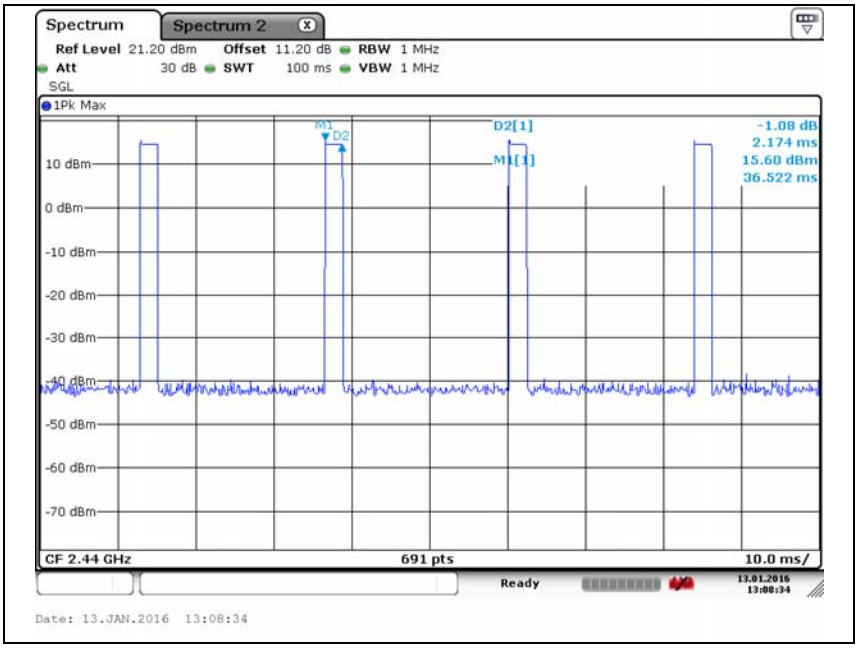
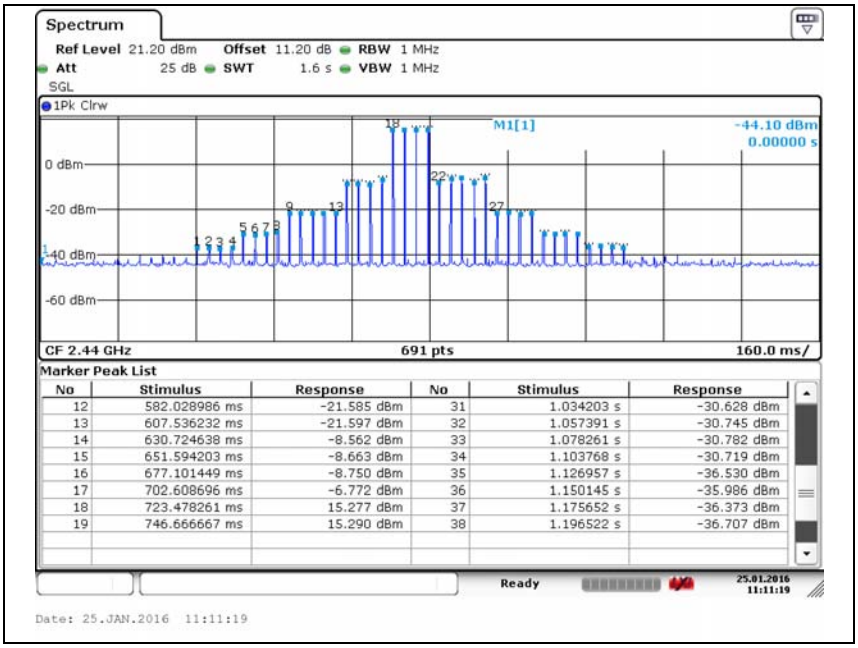
Frequency (㎒)	Burst time (ms)	Burst number	Time of occupancy (ms)	Limit (ms)
2 440	2.174	152	330.448	400



Burst time(㎳) = 2.174



No	Stimulus	Response	No	Stimulus	Response
12	582.028986 ms	-21.585 dBm	31	1.034203 s	-30.628 dBm
13	607.536232 ms	-21.597 dBm	32	1.057391 s	-30.745 dBm
14	630.724638 ms	-8.562 dBm	33	1.078261 s	-30.782 dBm
15	651.594203 ms	-8.663 dBm	34	1.103768 s	-30.719 dBm
16	677.101449 ms	-8.750 dBm	35	1.126957 s	-36.530 dBm
17	702.608696 ms	-6.772 dBm	36	1.150145 s	-35.986 dBm
18	723.478261 ms	15.277 dBm	37	1.175652 s	-36.373 dBm
19	746.666667 ms	15.290 dBm	38	1.196522 s	-36.707 dBm

Burst number within 1.6 s = 38

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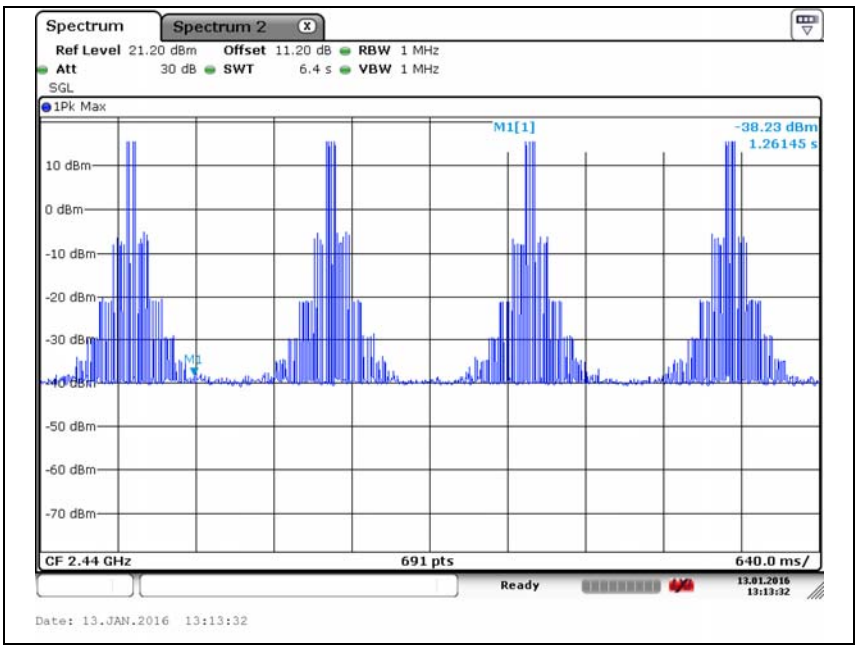

Burst number within 6.4 s = 38 × 4 = 152

3.8. AC conducted emissions

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:

1. All modes of operation, data rates, and test channels were investigated and the worst-case emissions are reported in GFSK mode Channel 16. The emissions found were not affected by the choice of channel used during testing.
2. The limit for Class B device(s) from 150 ㎑ to 30 ㎒ are specified in Section 15.207 of the Title 47 CFR.
3. Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).
4. Deviations to the Specifications: None.

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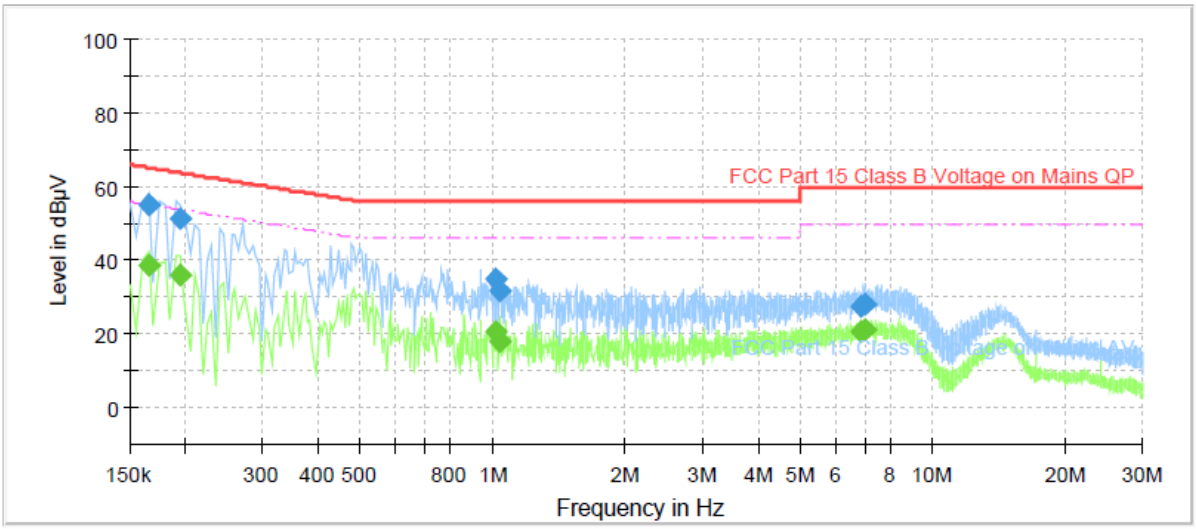
Test results

Test Report

Common Information

Test Description:	Conducted Emission
Model No.:	SEW-3042WN
Mode	TX
Operator Name:	KES



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.165000	---	38.65	55.21	16.56	1000.0	9.000	L1	9.7
0.165000	54.94	---	65.21	10.27	1000.0	9.000	L1	9.7
0.195000	---	35.85	53.82	17.97	1000.0	9.000	L1	9.7
0.195000	51.58	---	63.82	12.24	1000.0	9.000	L1	9.7
1.010000	---	20.66	46.00	25.34	1000.0	9.000	L1	9.7
1.010000	34.91	---	56.00	21.09	1000.0	9.000	L1	9.7
1.040000	---	18.23	46.00	27.77	1000.0	9.000	L1	9.7
1.040000	31.99	---	56.00	24.01	1000.0	9.000	L1	9.7
6.855000	---	20.81	50.00	29.19	1000.0	9.000	L1	9.9
6.855000	27.35	---	60.00	32.65	1000.0	9.000	L1	9.9
7.045000	---	21.12	50.00	28.88	1000.0	9.000	L1	9.9
7.045000	28.28	---	60.00	31.72	1000.0	9.000	L1	9.9

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

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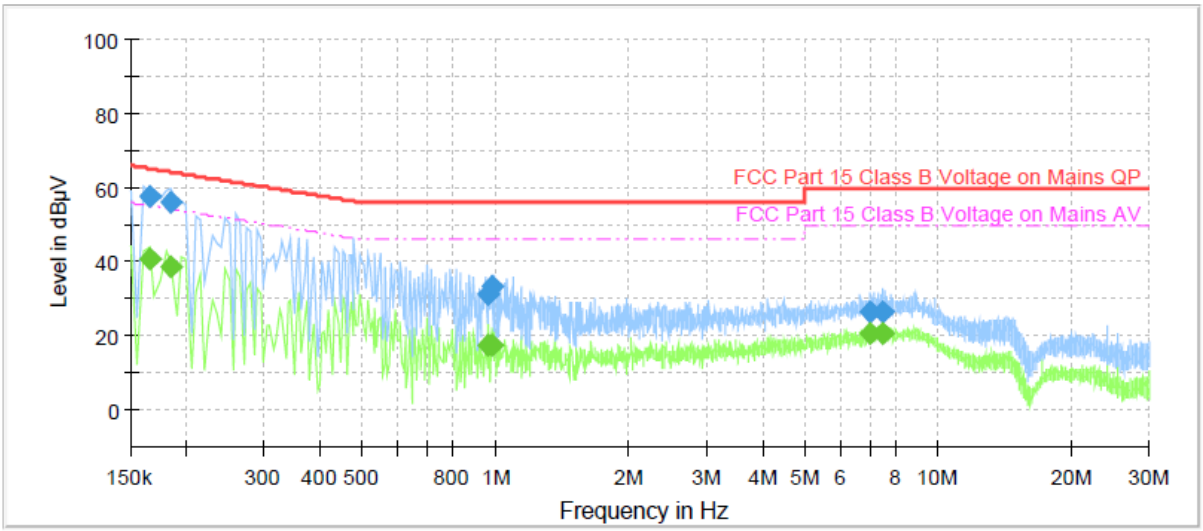
Test Report

Common Information

Test Description:	Conducted Emission
Model No.:	SEW-3042WN
Mode	TX
Operator Name:	KES



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.165000	---	40.86	55.21	14.35	1000.0	9.000	N	9.6
0.165000	57.47	---	65.21	7.74	1000.0	9.000	N	9.6
0.185000	---	38.69	54.26	15.57	1000.0	9.000	N	9.7
0.185000	55.91	---	64.26	8.35	1000.0	9.000	N	9.7
0.965000	---	17.24	46.00	28.76	1000.0	9.000	N	9.7
0.965000	31.04	---	56.00	24.96	1000.0	9.000	N	9.7
0.980000	---	17.30	46.00	28.70	1000.0	9.000	N	9.7
0.980000	33.29	---	56.00	22.71	1000.0	9.000	N	9.7
7.045000	---	20.60	50.00	29.40	1000.0	9.000	N	9.9
7.045000	26.41	---	60.00	33.59	1000.0	9.000	N	9.9
7.520000	---	20.82	50.00	29.18	1000.0	9.000	N	9.9
7.520000	26.70	---	60.00	33.30	1000.0	9.000	N	9.9

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	FSV40	101002	1 year	2016.07.25
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2017.01.25
Attenuator	HP	8493C	51401	1 year	2016.07.24
Loop Antenna	R&S	HFH2-Z2.335.4711.52	826532	2 years	2017.03.03
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-461	2 years	2017.04.03
Horn Antenna	A.H. System	SAS-571	414	2 years	2017.02.09
Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170550	2 years	2017.04.30
High Pass Filter	Wainwright Instrument	WHJS3000-10TT	1	1 year	2016.07.24
Preamplifier	SCHWARZBECK	BBV-9718	9718-246	1 year	2016.10.23
Broadband Amplifier	SCHWARZBECK	BBV-9721	PS9721-003	1 year	2016.04.03
EMI Test Receiver	R & S	ESR3	101781	1 year	2016.05.06
EMI Test Receiver	R & S	ESR3	101783	1 year	2016.05.06
LISN	R & S	ENV216	101137	1 year	2016.02.10

Peripheral devices

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

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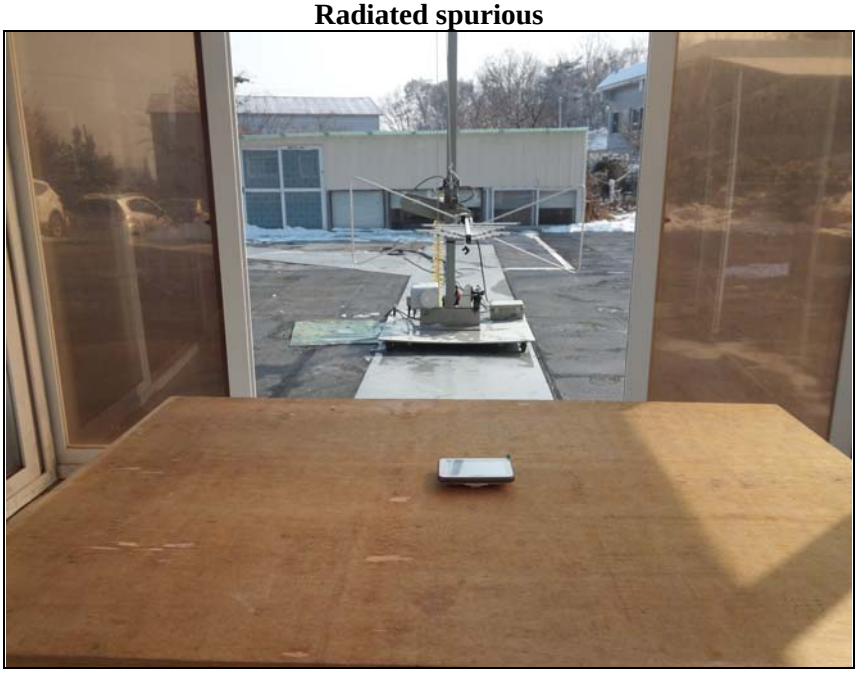
Appendix B. Test setup photo

Radiated spurious



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AC conducted emission

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