TEST REPORT

Part 15 Subpart C 15.247

Equipment under test Optical PARTICLE COUNTER

Model name GIS-PSMPC2

FCC ID A3LGIS-PSMPC2

Applicant Samsung Electronics Co Ltd

Manufacturer Samsung Electronics Co Ltd

Date of test(s) 2017.12.14 ~ 2017.12.20, 2018.01.09

Date of issue 2018.01.10

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Revision history

Revision	Date of issue	Test report No.	Description
-	2017.12.22	KES-RF-17T0139	Initial
R1	2018.01.10	KES-RF-17T0139-R1	Added output power test

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1. General information

Applicant:	Samsung Electronics Co Ltd
Applicant address:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Republic of Korea
Test site:	KES Co., Ltd.
Test site address:	C-3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
Test Facility	FCC Accreditation Designation No.: KR0100, Registration No.: 444148
FCC rule part(s):	15.247
FCC ID:	A3LGIS-PSMPC2
Test device serial No.:	☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	Optical PARTICLE COUNTER
Frequency range	2 412 ㎒ ~ 2 462 ㎒(802.11b) 5 745 ㎒ ~ 5 825 ㎒(802.11a), 5 180 ㎒ ~ 5 240 ㎒(802.11a)
Model:	GIS-PSMPC2
Modulation technique	DSSS, OFDM
Number of channels	2 412 ㎒ ~ 2 462 ㎒(802.11 b) : 11ch 5 745 ㎒ ~ 5 825 ㎒(802.11a) : 5ch 5 180 ㎒ ~ 5 240 ㎒(802.11a) : 4ch

Antenna specification	Dipole Antenna (2.4 ㎓) // Peak gain: 3.77 ㏈i
	Dipole Antenna (5.1 ㎓) // Peak gain: 3.92 ㏈i
	Dipole Antenna (5.8 ㎓) // Peak gain: 3.07 ㏈i

Power source	AC 110V Adapter (Output : DC 12V / 3.5A)

Note:

1. Certificated module is mounted in the EUT as following
   - Applicant: Murata Manufacturing Co., Ltd.
   - Contains FCC ID : VPYLB1GC
   - Model: Type1GC
   - RF test report number: RF160104C01, RF160104C01-1, RF160104C01-2
2. This device supported only 802.11a/b mode and the installed module is completed identical as original except antenna change. And it does not support UNII 2A/2C, this band disabled by software
3. The output power setting is same as original module and confirmed that RF conducted tests of original report remain valid for this filing.

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1.2. Test configuration

The **Samsung Electronics Co Ltd FCC ID: A3LGIS-PSMPC2** was tested per the guidance of KDB 558074 D01 v04. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

1.3. Device modifications

N/A

1.4. Derivation model information

N/A

1.5. Frequency/channel operations

Ch.	Frequency (㎒)	Mode
01	2412	802.11b
. .	. .	. .
06	2437	802.11b
. .	. .	. .
11	2462	802.11b

1.6. Worst case data rate

1. Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.
2. Worst-case data rates were:
   802.11b: **1 Mbps**

1.7. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
AC/DC ADAPTER	POWER-TEK	SW42-12003500-W	N/A	100~240V

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2. Summary of tests

Reference	Parameter	Test results
15.247(b)(3)	Peak output power	Pass
15.205 15.209	Radiated spurious emission	Pass
15.207	AC conducted emissions	Pass

Note:

1. For conducted test, Please refers to BV Report Number : RF160104C01, RF160104C01-1, RF160104C01-2

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3. Test results

3.1. Output power

Test procedure

KDB 558074 D01 v04 – section 9.1.1 or 9.1.3 and 9.2.3.2
Used test method is section 9.1.3 , 9.2.3.2

Section 9.1.1

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

1. Set the RBW ≥ DTS bandwidth.
2. Set VBW ≥ 3 × RBW.
3. Set span ≥ 3 × RBW
4. Sweep time = auto couple
5. Detector = peak
6. Trace mode = max hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level

Section 9.1.3

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 ba ndwidth and shall utilize a fast-responding diode detector.

Section 9.2.3.2

Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

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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Test results

Measured output power (dBm)						
Mode	2412 MHz		2437 MHz		2462 MHz	
	Peak	Average	Peak	Average	Peak	Average
11b	19.75	16.88	19.64	16.70	19.82	16.90

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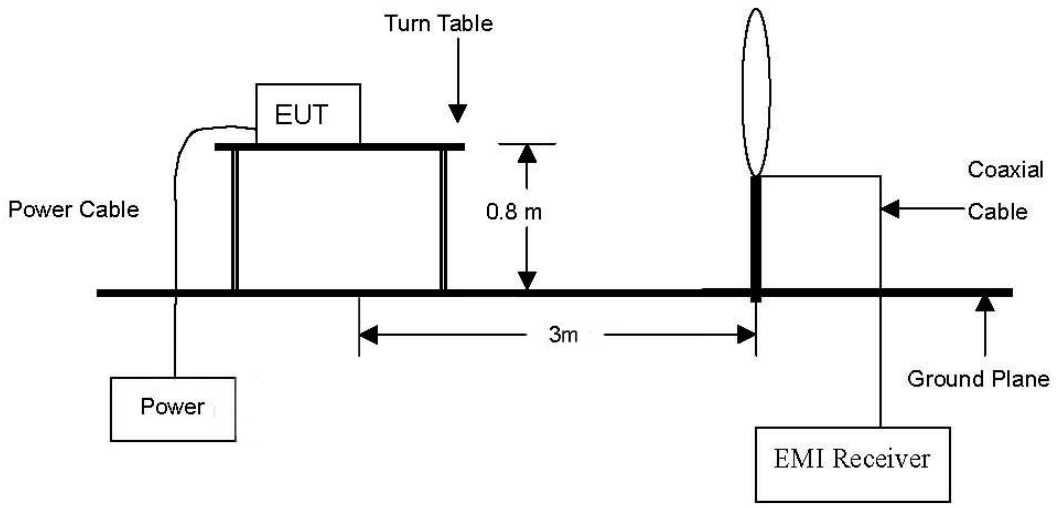
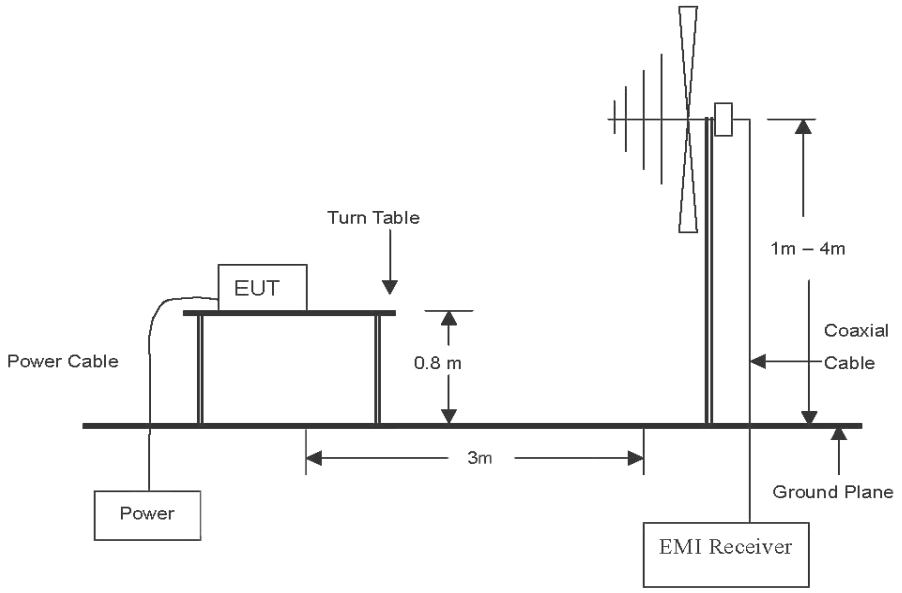
3.2. Radiated restricted band and emissions

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.



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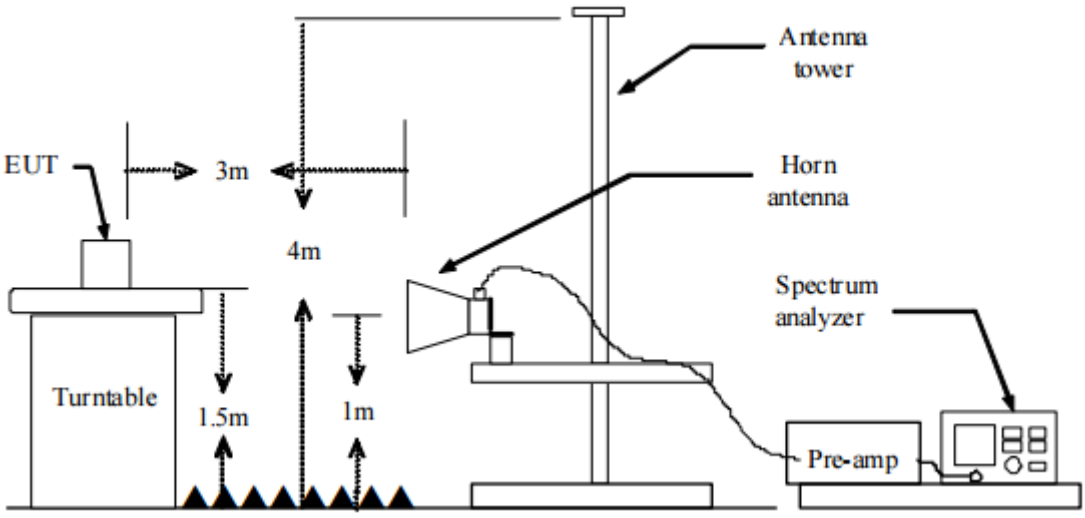
The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



Test procedure below 30 ㎒

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. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum hold mode.

Test procedure above 30 ㎒

1. Spectrum analyzer settings for f < 1 ㎓:
   ① Span = wide enough to fully capture the emission being measured
   ② RBW = 100 ㎑
   ③ VBW ≥ RBW
   ④ Detector = quasi peak
   ⑤ Sweep time = auto
   ⑥ Trace = max hold
2. Spectrum analyzer settings for f ≥1 ㎓: Peak
   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
   ⑥ Trace = max hold
   ⑦ Trace was allowed to stabilize

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3. Spectrum analyzer settings for $f \geq 1$ ㎓: Average
   ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
   ② RBW = 1 ㎒
   ③ VBW ≥ 3 × RBW
   ④ Detector = RMS, if span/(# of points in sweep) ≤ (RBW/2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
   ⑤ Averaging type = power(i.e., RMS)
      1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
      2) Some instruments require linear display mode in order to use linear voltage averaging. Log or ㏈ averaging shall not be used.
   ⑥ Sweep = auto
   ⑦ Trace = max hold
   ⑧ Perform a trace average of at least 100 traces.
   ⑨ A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

      1) If power averaging (RMS) mode was used in step ⑤, then the applicable correction factor is 10 log(1/x), where x is the duty cycle.
      2) If linear voltage averaging mode was used in step ⑤, then the applicable correction factor is 20 log(1/x), where x is the duty cycle.
      3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

Note.

1. f<30 ㎒, extrapolation factor of 40 ㏈/decade of distance. $F_d = 40\log(D_m/Ds)$
   $f \geq 30$ ㎒, extrapolation factor of 20 ㏈/decade of distance. $F_d = 20\log(D_m/Ds)$
   Where:
   F_d = Distance factor in ㏈
   D_m = Measurement distance in meters
   D_s = Specification distance in meters
3. CF(Correction factors(㏈)) = Antenna factor(㏈/m) + Cable loss(㏈) + or Amp. gain(㏈) + or F_d(㏈)
4. Field strength(㏈㎶/m) = Level(㏈㎶) + CF (㏈) + or DCF(㏈)
5. Margin(㏈) = Limit(㏈㎶/m) - Field strength(㏈㎶/m)
6. 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.
7. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z, it was determined that **X orientation** was worst-case orientation; therefore, all final radiated testing was performed with the EUT in **X orientation.**
8. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ of respective limits were not reported.

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9. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

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	2400/F(㎑)
0.490 ~ 1.705	30	24000/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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Duty cycle

Regarding to KDB 558074 D01_v04, 6.0, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below.

Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

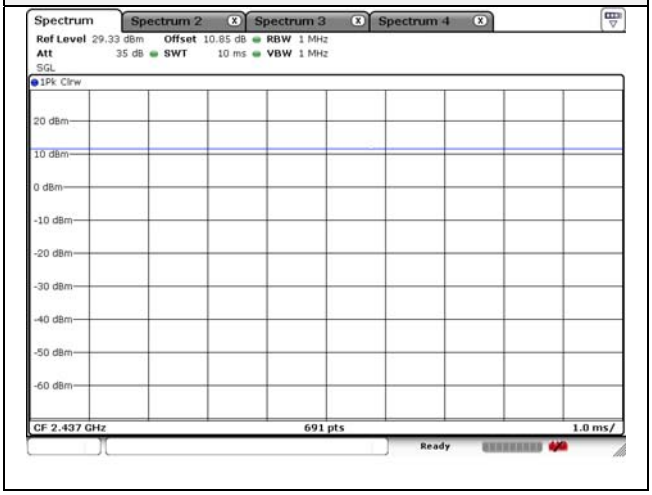
Test mode	T_{on} time (㎳)	Period (㎳)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (㏈)
802.11b	10.00	10.00	1	100	0

`.

Duty cycle (Linear) = T_{on} time/Period

DCF(Duty cycle correction factor (㏈)) = 10log(1/duty cycle)

802.11b // Middle channel



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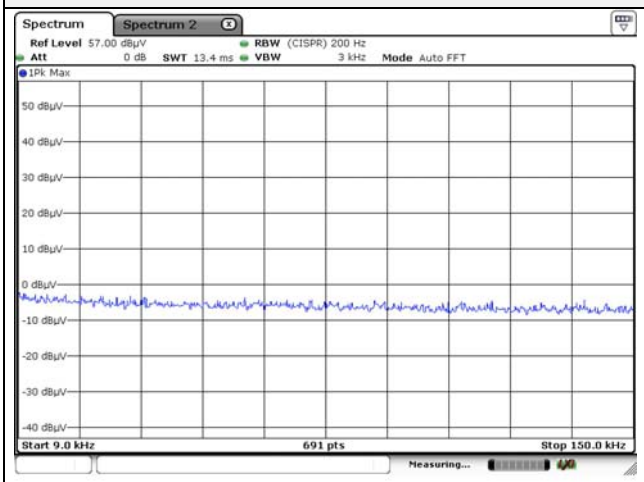
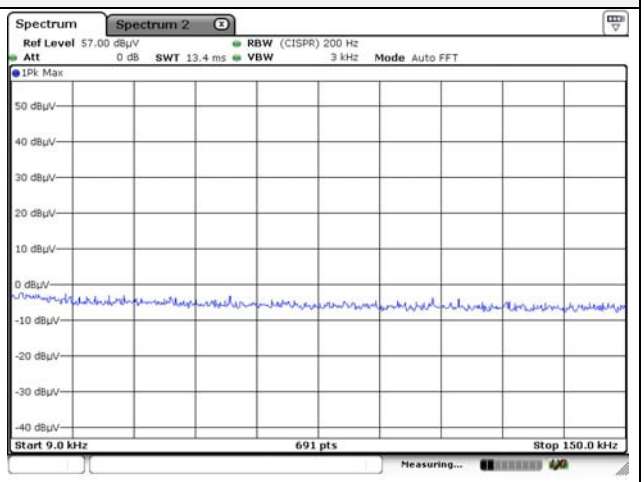
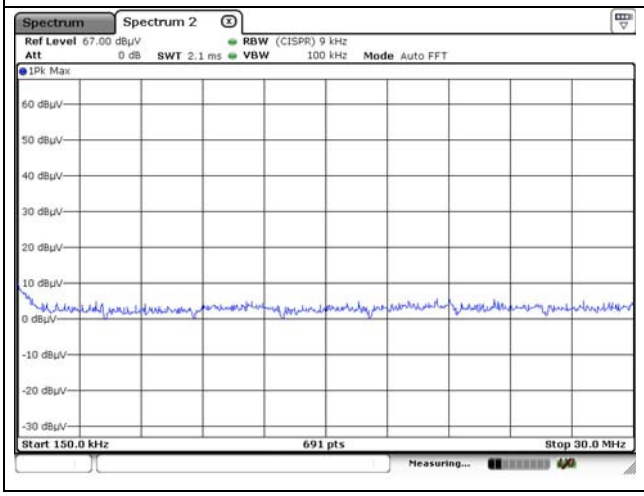
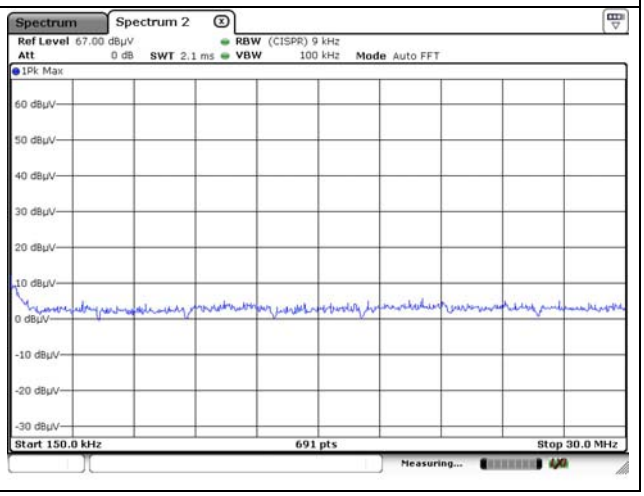
Test results (Below 30 ㎒)

Mode: 802.11b

Distance of measurement: 3 meter

Channel: 1

Frequency (㎒)	Level (dBμV)	Ant. Pol. (H/V)	CF (dB)	F_d (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No spurious emissions were detected within 20 dB of the limit							

Horizontal	Vertical
	
	

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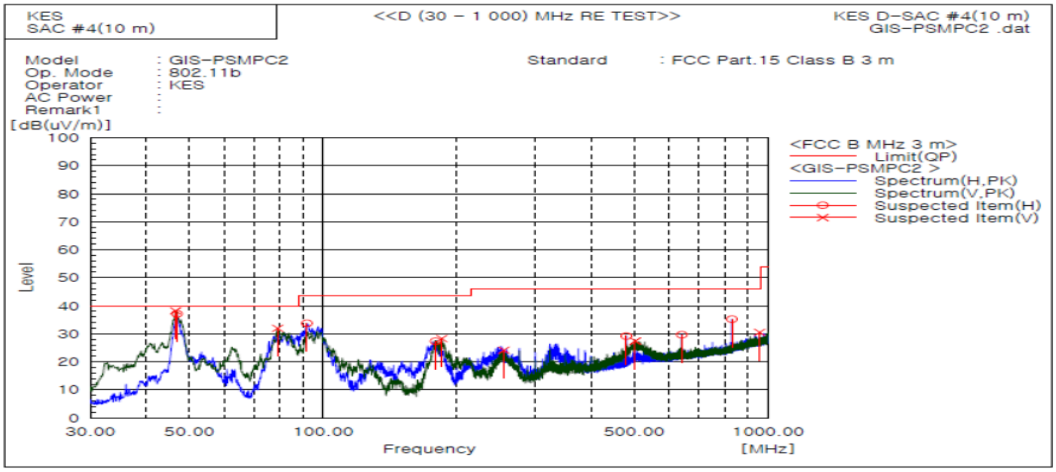
Test results (Below 1 000 ㎒)

Mode: 802.11b

Distance of measurement: 3 meter

Channel: 1

Horizontal / Vertical



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Remark
1	46.975	H	65.3	-28.2	37.1	40.0	2.9	
2	91.959	H	64.2	-30.5	33.7	43.5	9.8	
3	178.895	H	57.8	-30.5	27.3	43.5	16.2	
4	480.080	H	47.8	-18.6	29.2	46.0	16.8	
5	640.130	H	44.5	-14.8	29.7	46.0	16.3	
6	829.644	H	47.5	-12.3	35.2	46.0	10.8	
7	46.611	V	66.5	-28.3	38.2	40.0	1.8	
8	78.985	V	66.6	-34.6	32.0	40.0	8.0	
9	184.836	V	58.0	-29.7	28.3	43.5	15.2	
10	255.040	V	50.0	-25.9	24.1	46.0	21.9	
11	503.118	V	45.3	-17.9	27.4	46.0	18.6	
12	957.320	V	40.6	-10.1	30.5	46.0	15.5	

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Test results (Above 1 000 ㎒)

Mode: 802.11b

Distance of measurement: 3 meter

Channel: 01

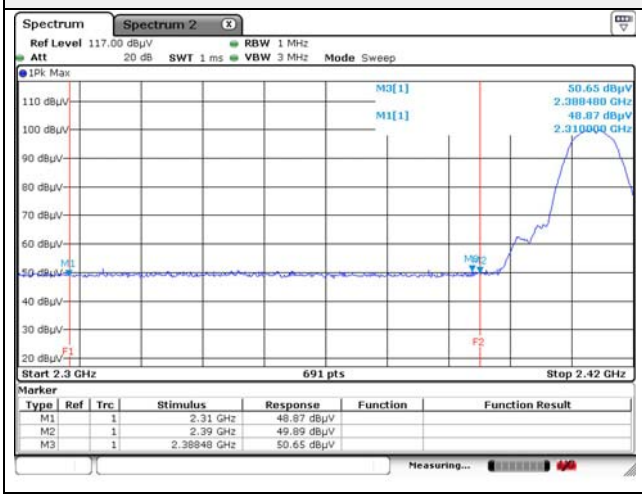
- **Spurious**

Frequency (㎒)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1206.90	52.71	Peak	H	-7.81	-	44.90	74.00	29.10
1206.90	51.41	Peak	V	-7.81	-	43.60	74.00	30.40

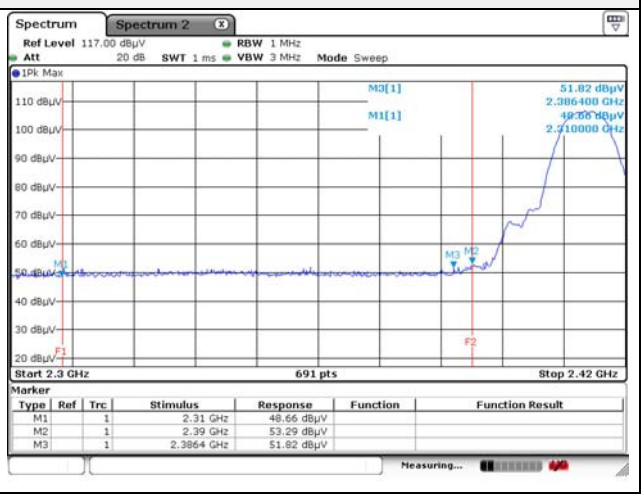
- **Band edge**

Frequency (㎒)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2388.48	50.65	Peak	H	-0.22	-	50.43	74.00	23.57
2386.40	51.82	Peak	V	-0.23	-	51.59	74.00	22.41

Restricted band // Horizontal // Peak



Restricted band // Vertical // Peak



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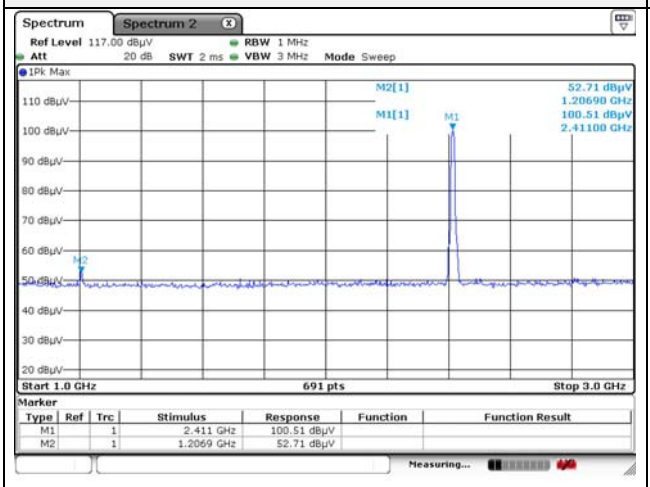
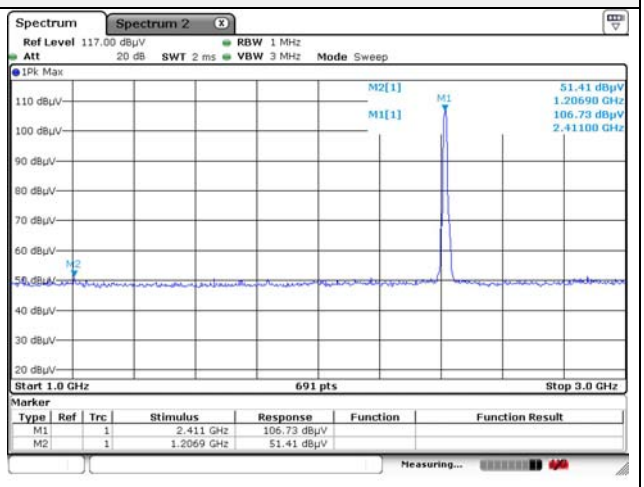
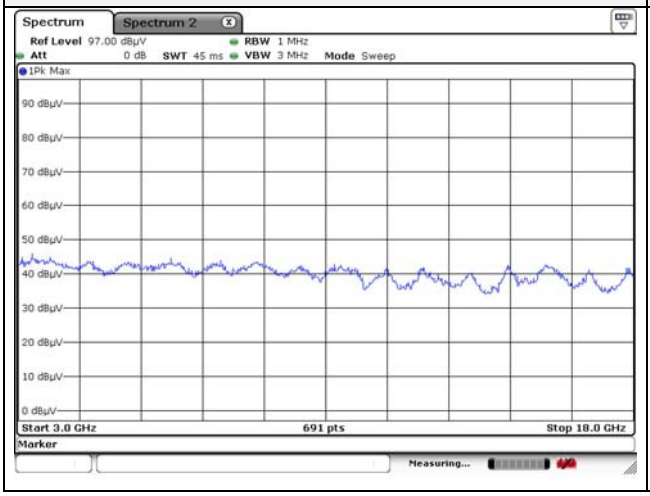
Horizontal // Peak for 1 ㎓ to 3 ㎓



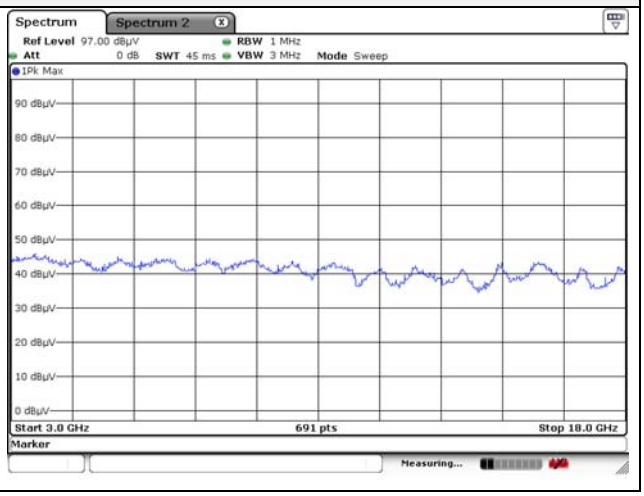
Vertical // Peak for 1 ㎓ to 3 ㎓



Horizontal // Peak for 3 ㎓ to 18 ㎓



Vertical // Peak for 3 ㎓ to 18 ㎓



Note.

1. Average test was not performed because peak result is lower than the average limit.
2. No spurious emission were detected above 3 ㎓.

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Mode: 802.11b

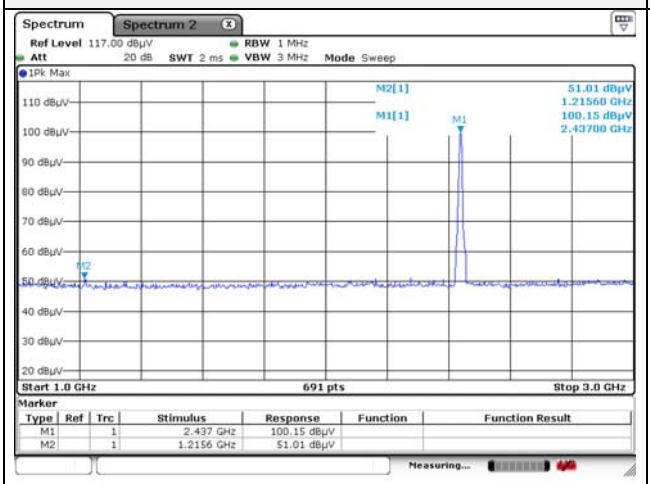
Distance of measurement: 3 meter

Channel: 06

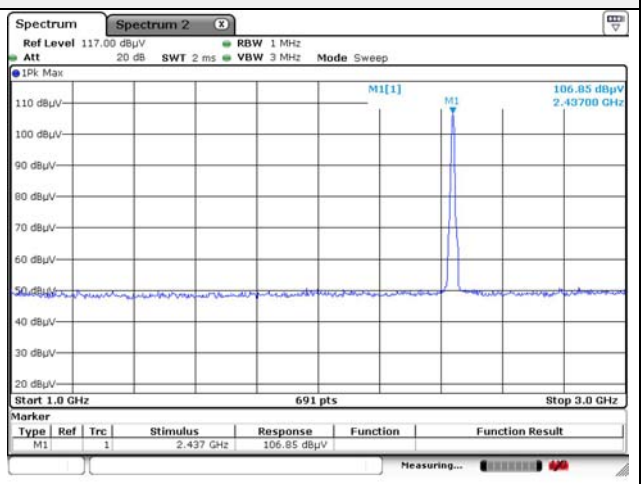
- **Spurious**

Frequency (㎒)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1215.60	51.01	Peak	H	-7.76	-	43.25	74.00	30.75

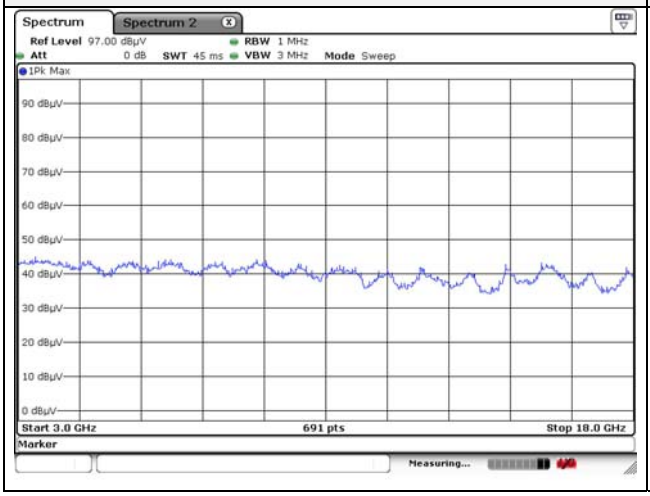
Horizontal // Peak for 1 ㎓ to 3 ㎓



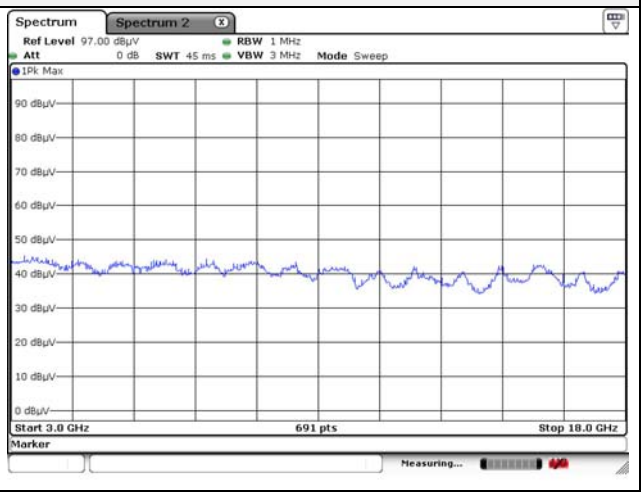
Vertical // Peak for 1 ㎓ to 3 ㎓



Horizontal // Peak for 3 ㎓ to 18 ㎓



Vertical // Peak for 3 ㎓ to 18 ㎓



Note.

1. Average test was not performed because peak result is lower than the average limit.
2. No spurious emission were detected above 3 ㎓.

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Mode: 802.11b

Distance of measurement: 3 meter

Channel: 11

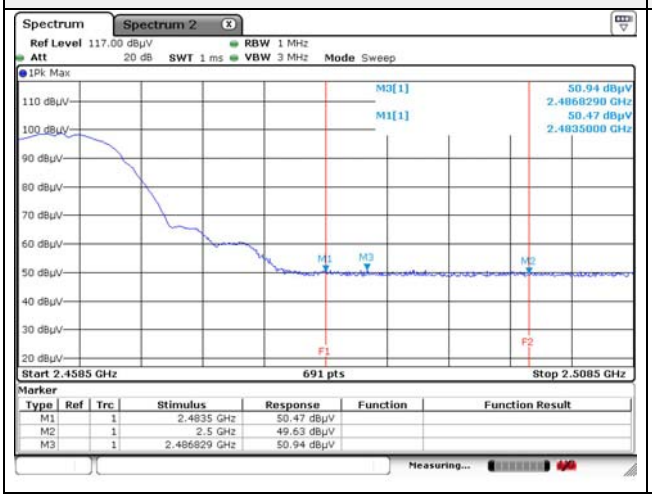
- **Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1230.10	51.44	Peak	H	-7.67	-	43.77	74.00	30.23

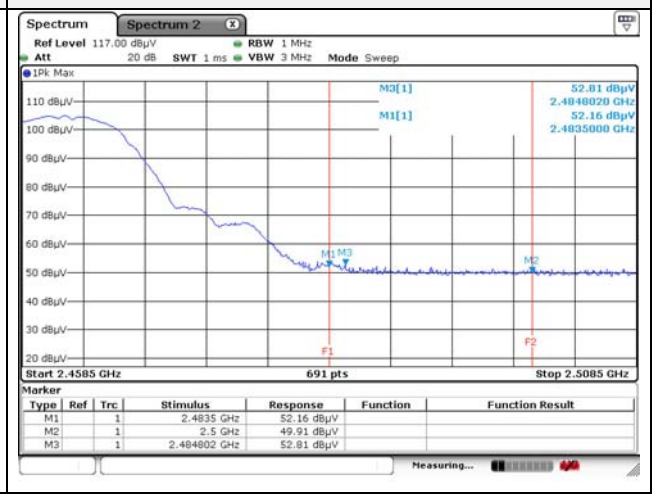
- **Band edge**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2486.83	50.94	Peak	H	-0.04	-	50.90	74.00	23.10
2484.80	52.81	Peak	V	-0.04	-	52.77	74.00	21.23

Restricted band // Horizontal // Peak



Restricted band // Vertical // Peak



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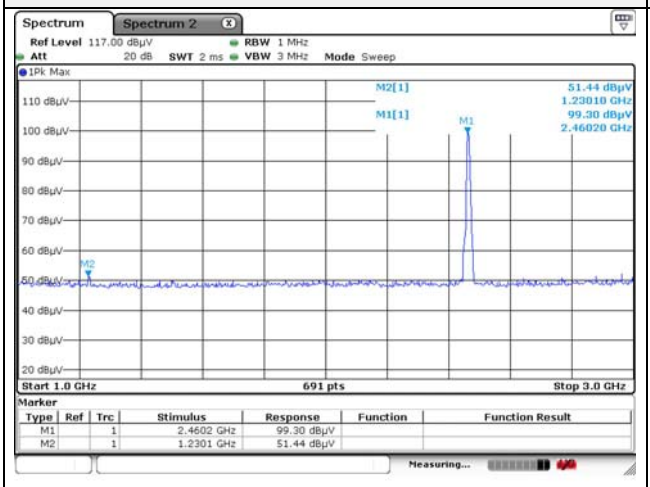
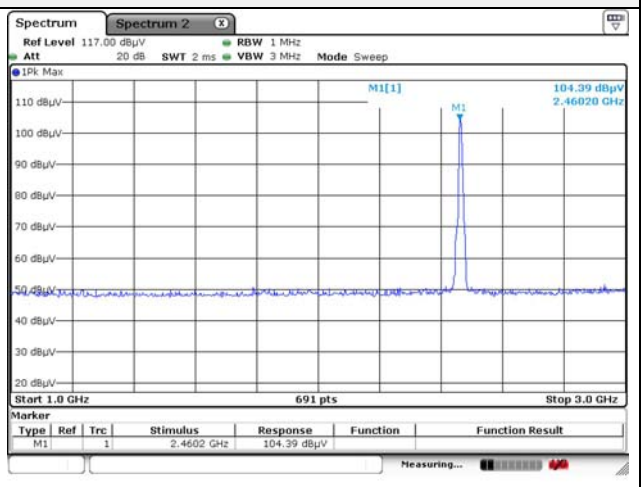
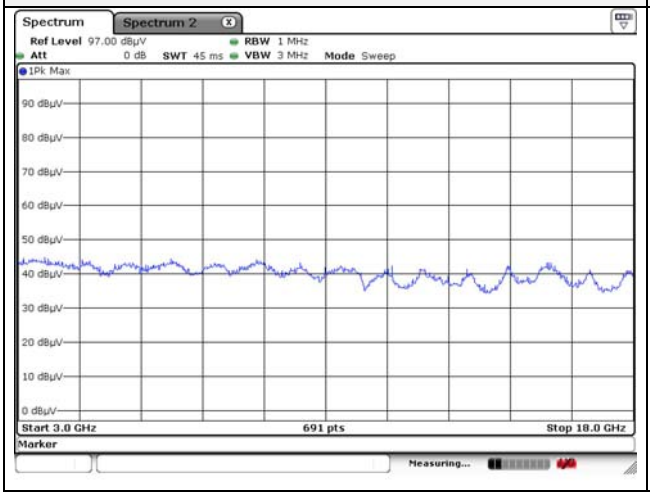
Horizontal // Peak for 1 ㎓ to 3 ㎓



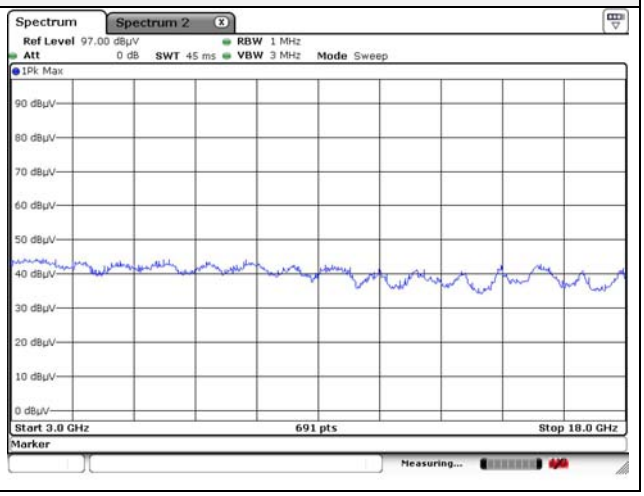
Vertical // Peak for 1 ㎓ to 3 ㎓



Horizontal // Peak for 3 ㎓ to 18 ㎓



Vertical // Peak for 3 ㎓ to 18 ㎓



Note.

1. Average test was not performed because peak result is lower than the average limit.
2. No spurious emission were detected above 3 ㎓.

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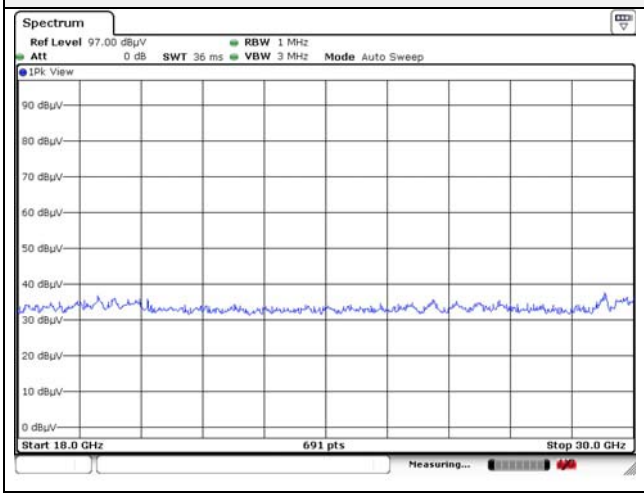
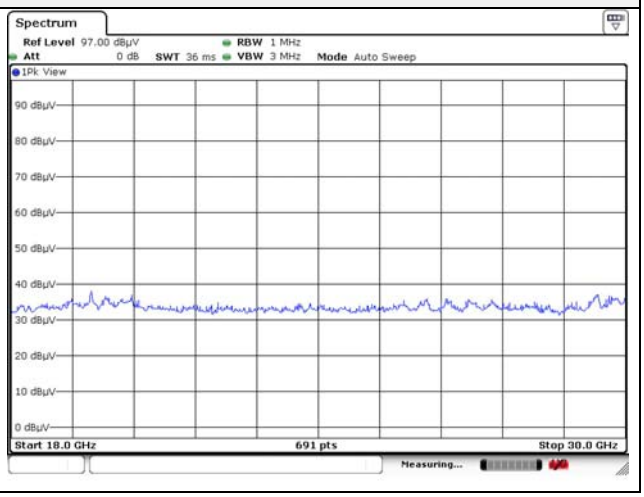
Test results (18 ㎓ to 30 ㎓)

Mode: 802.11b

Distance of measurement: 3 meter

Channel: 1

Horizontal	Vertical
	

Note.

1. No spurious emission were detected above 18 ㎓.

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3.3. 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 AC line conducted spurious emission are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and the appropriate frequencies. All data rates and modes were investigated for conducted spurious emission. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.
3. Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).

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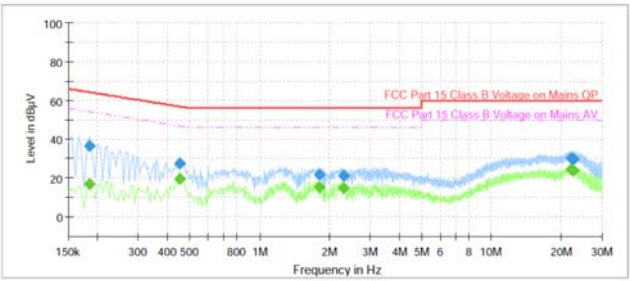
Test results

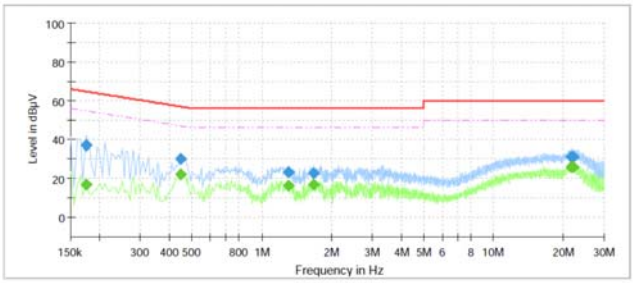
Hot Line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.185000	---	17.00	54.26	37.26	1000.0	9.000	L1	19.5
0.185000	36.45	---	64.26	27.81	1000.0	9.000	L1	19.5
0.450000	---	19.66	46.88	27.22	1000.0	9.000	L1	19.7
0.450000	27.66	---	56.88	29.22	1000.0	9.000	L1	19.7
1.810000	---	15.52	46.00	30.48	1000.0	9.000	L1	20.2
1.810000	21.75	---	56.00	34.25	1000.0	9.000	L1	20.2
2.305000	---	14.71	46.00	31.29	1000.0	9.000	L1	20.2
2.305000	21.31	---	56.00	34.69	1000.0	9.000	L1	20.2
22.190000	---	24.54	50.00	25.46	1000.0	9.000	L1	20.4
22.190000	29.94	---	60.00	30.06	1000.0	9.000	L1	20.4
22.465000	---	23.87	50.00	26.13	1000.0	9.000	L1	20.4
22.465000	29.40	---	60.00	30.60	1000.0	9.000	L1	20.4

Neutral Line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.175000	---	16.91	54.72	37.81	1000.0	9.000	N	19.5
0.175000	37.30	---	64.72	27.42	1000.0	9.000	N	19.5
0.445000	---	22.13	46.97	24.84	1000.0	9.000	N	19.7
0.445000	30.27	---	56.97	26.70	1000.0	9.000	N	19.7
1.305000	---	16.61	46.00	29.39	1000.0	9.000	N	20.1
1.305000	23.06	---	56.00	32.94	1000.0	9.000	N	20.1
1.675000	---	17.22	46.00	28.78	1000.0	9.000	N	20.2
1.675000	22.64	---	56.00	33.36	1000.0	9.000	N	20.2
21.600000	---	26.13	50.00	23.87	1000.0	9.000	N	20.5
21.600000	31.28	---	60.00	28.72	1000.0	9.000	N	20.5
22.125000	---	25.91	50.00	24.09	1000.0	9.000	N	20.5
22.125000	31.25	---	60.00	28.75	1000.0	9.000	N	20.5

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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	2018.07.04
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2018.01.23
Power Meter	Anritsu	ML2495A	1438001	1 year	2018.01.23
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2018.01.23
AC Power Source	HP	6813A	3729A00754	1 year	2018.01.19
Attenuator	Agilent	8493C	51401	1 year	2018.07.04
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2019.05.10
Trilog-broadband antenna	SCHWARZBECK	VULB 9163	9168-714	2 years	2018.11.28
Horn Antenna	A.H	SAS-571	414	2 years	2019.02.15
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170550	2 years	2019.02.15
High Pass Filter	Wainwright Instrument Gmbh	WHJS3000-10TT	1	1 year	2018.07.03
Low Pass Filter	Wainwright Instrument Gmbh	WLK1.0/18G-10TT	1	1 year	2018.07.03
Preamplifier	HP	8449B	3008A00538	1 year	2018.01.19
Preamplifier	AGILENT	8449B	3008A01729	1 year	2018.05.31
EMI Test Receiver	R&S	ESR3	101781	1 year	2018.04.27
EMI Test Receiver	R&S	ESU26	100552	1 year	2018.04.19
LISN	R&S	ENV216	101787	1 year	2018.01.11

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook Computer	LG Electronics Inc.,	LGS53	306QCZP560949
Test Board	N/A	N/A	N/A

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