TEST REPORT

Part 15 Subpart C 15.249

Equipment under test Outdoor, Battery-Powered Camera

Model name SNW-R0130BW

FCC ID NLMSNWR0130BW

Applicant Hanwha Techwin Co., Ltd.

Manufacturer Hanwha Techwin(Tianjin) Co., Ltd

Date of test(s) 2017.02.09 ~ 2017.02.21

Date of issue 2017.02.22

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	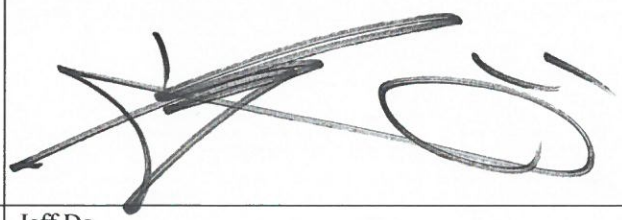
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Revision history

Revision	Date of issue	Test report No.	Description
-	2017.02.22	KES-RF-17T0021	Initial

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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):	15.249
FCC ID:	NLMSNWR0130BW
Test device serial No.:	☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	Outdoor, Battery-Powered Camera
Frequency range	2412 ㎒ ~ 2462 ㎒(11b/g/n_HT20) 920.6 ㎒ ~ 922.0 ㎒
Modulation technique	DSSS, OFDM, FSK
Number of channels	2412 ㎒ ~ 2462 ㎒(11b/g/n_HT20): 11ch 920.6 ㎒ ~ 922.0 ㎒: 8ch
Antenna type	2.4GHz Single module: PCB antenna 900MHz module : Chip antenna
Antenna gain	2.4GHz Single module: 1.2 dBi 900MHz module : -1.7 dBi
Power source	DC 6.0 V (Lithium Battery)

1.2. Test configuration

The **Hanwha Techwin Co., Ltd. Outdoor, Battery-Powered Camera FCC ID: NLMSNWR0130BW** was tested per the guidance of ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing.

1.3. Device modifications

N/A

1.4. Information about derivative model

N/A

1.5. Frequency/channel operations

Ch.	Frequency (㎒)
1	920.6
. .	. .
4	921.2
. .	. .
8	922.0

1.6. Accessory information

Applicant	Equipment	Manufacturer	Model	Power source
-	-	-	-	-

2. Summary of tests

Reference	Parameter	Test results
15.249(a)	Field strength of fundamental	Pass
15.205 15.209 15.249(d)	Radiated spurious emission, Out-of-band emission	Pass
15.215(c)	20 dB bandwidth	Pass

3. Test results

3.1. 20 dB bandwidth

Test procedure

ANSI C63.10-2013

Section 6.9.3

1. Use the following spectrum analyzer setting
2. Center frequency: Lowest, middle and highest channels
3. Span = approximately 2 to 3 times the 20dB bandwidth
4. RBW ≥ 1 % of the 20dB bandwidth
5. VBW ≥ 3 x RBW
6. Sweep = auto
7. Detector function = peak
8. Trace = max hold
9. 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 20 dB relative to the maximum level measured in the fundamental emission.

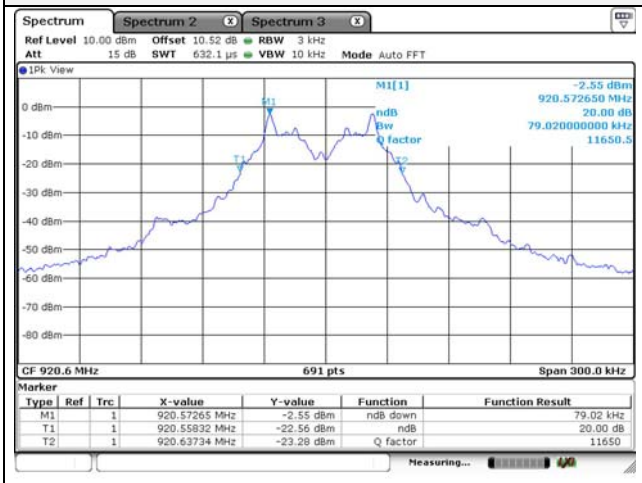
Limit

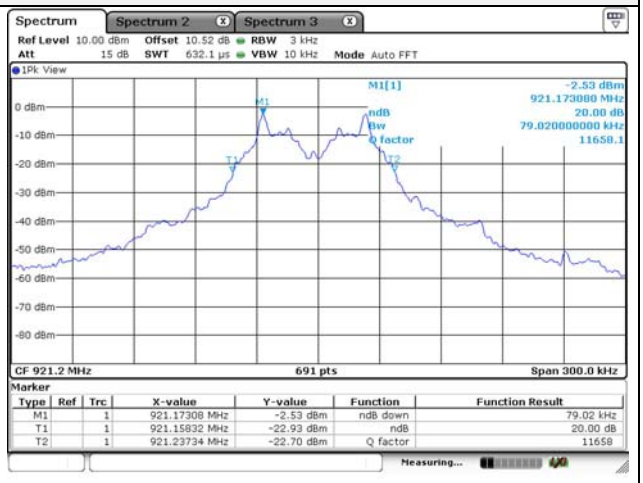
Not applicable

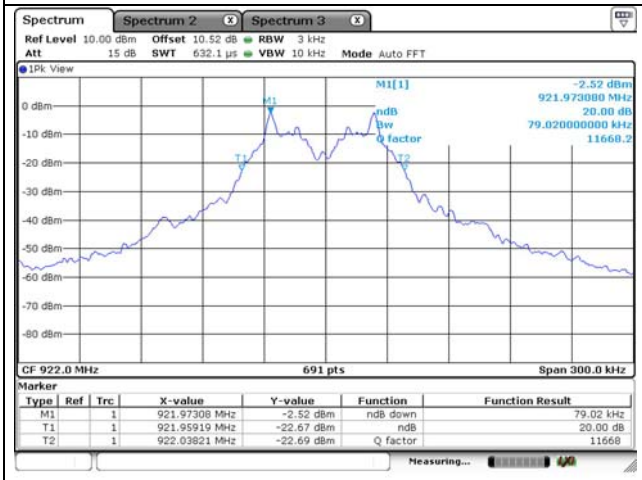
Test results

Frequency(㎒)	20 dB bandwidth(㎒)	Limit(㎒)
920.6	0.079	-
921.2	0.079	
922.0	0.079	

20 dB bandwidth







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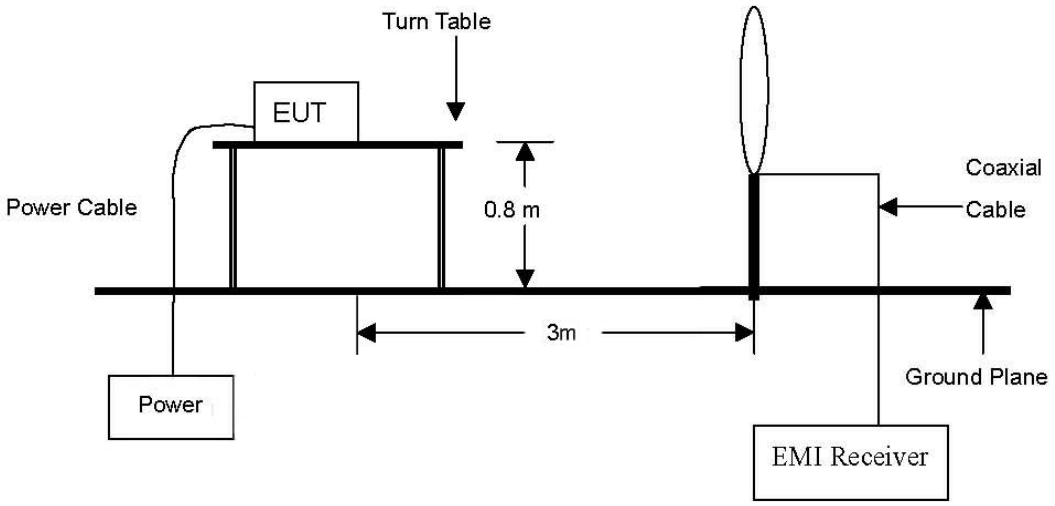
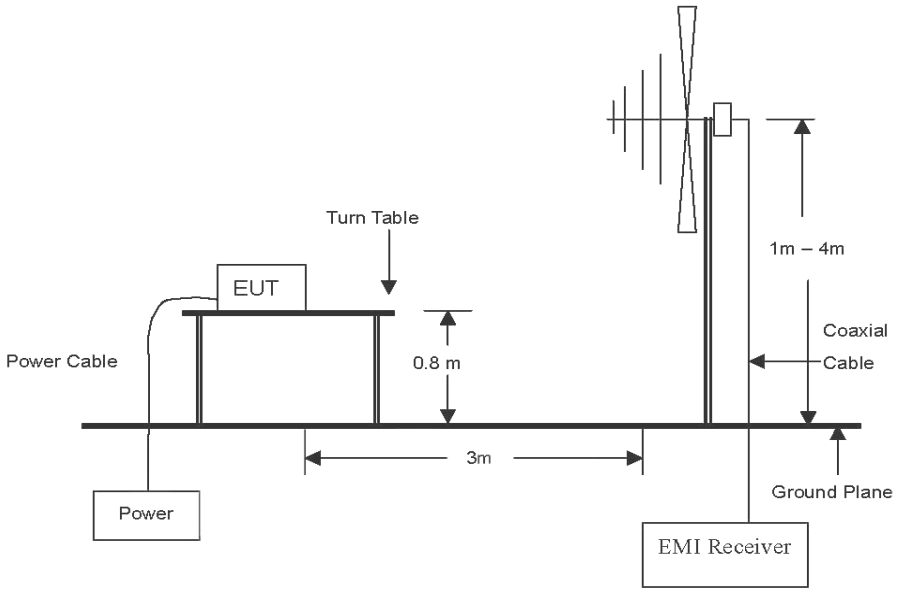
3.2. Field strength of fundamental & Radiated spurious emission & Out-of-band emission

Test setup

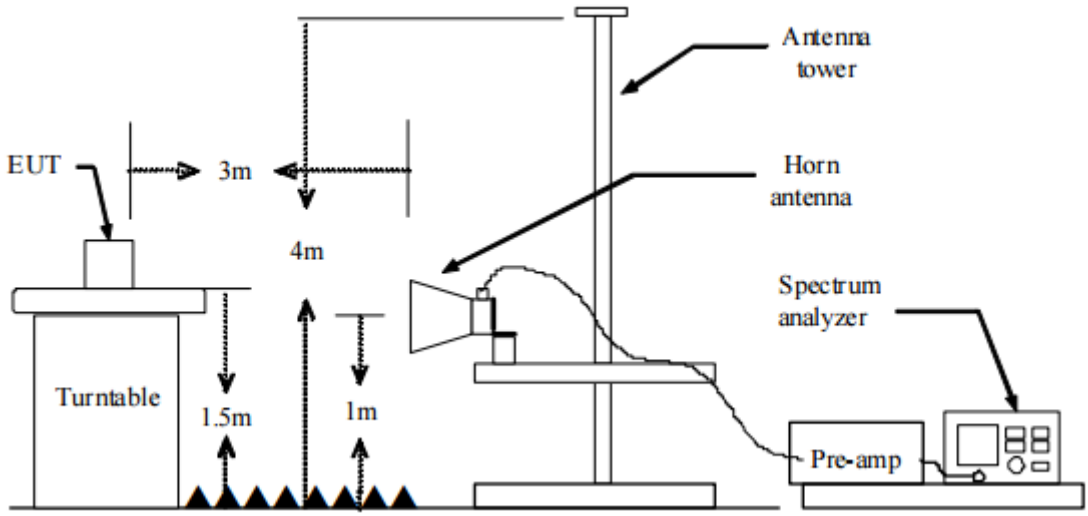
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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 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 $f \geq 1$ ㎓: 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

3. Spectrum analyzer settings for f ≥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 ≥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.

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.

According to 15.249(a)

Fundamental frequency	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBuV/m	uV/m	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	108	2500	68

According to 15.249(d)

Emission radiated outside of the specified frequency bands, except harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limit in FCC part 15C, Section 15.209, whichever is the lesser attenuation.

Test result (Fundamental)

Operating Frequency: 920.6 ㎒

Frequency (㎒)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
920.57	60.24	Peak	H	25.56	-	85.80	94.00	8.20
920.63	60.19	Peak	V	25.56	-	85.75	94.00	8.25

Operating Frequency: 921.2 ㎒

Frequency (㎒)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
921.23	60.05	Peak	H	25.56	-	85.61	94.00	8.39
921.18	60.10	Peak	V	25.56	-	85.66	94.00	8.34

Operating Frequency: 922.0 ㎒

Frequency (㎒)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
921.98	59.77	Peak	H	25.58	-	85.35	94.00	8.65
922.02	59.71	Peak	V	25.58	-	85.29	94.00	8.71

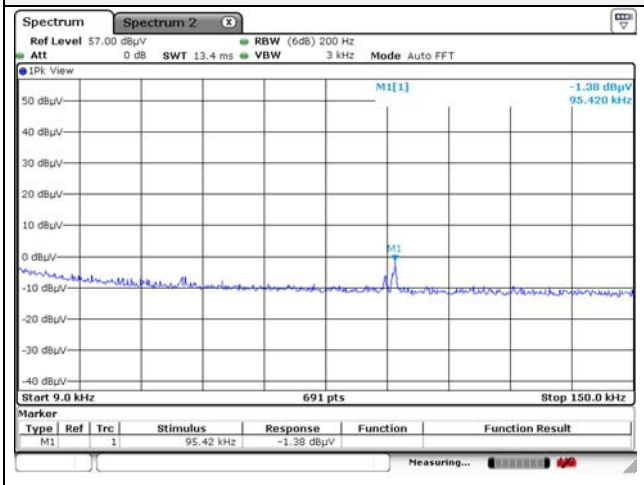
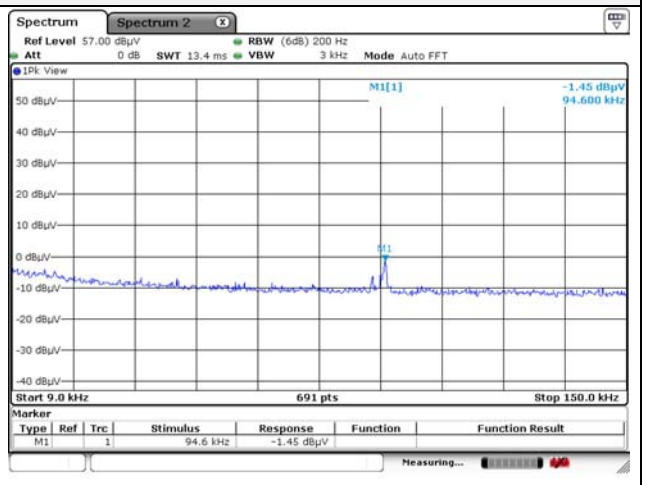
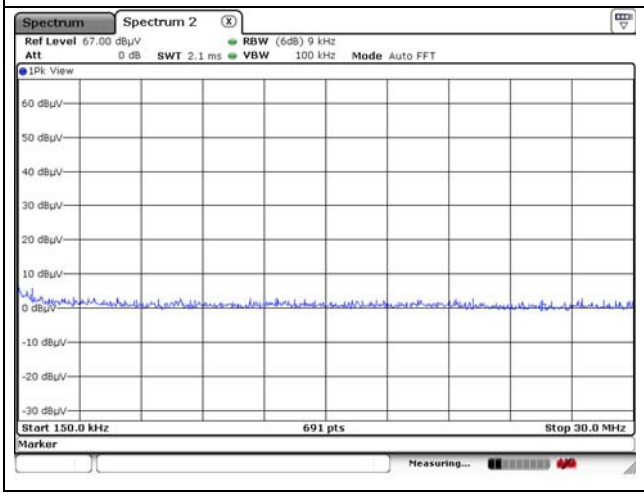
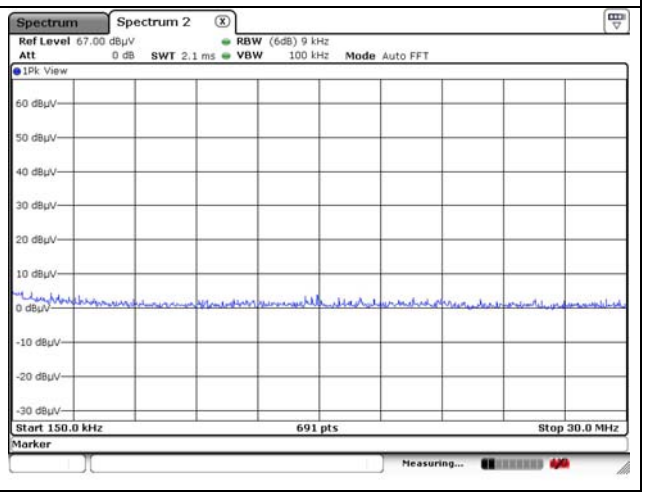
Test results (Below 30 ㎒)

Distance of measurement: 3 meter

Channel: 1 (Worst case)

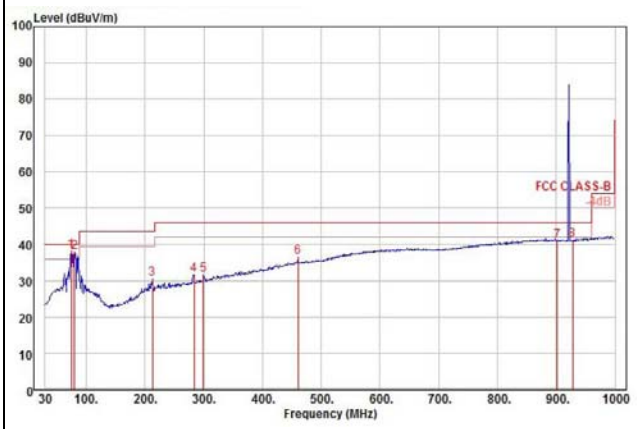
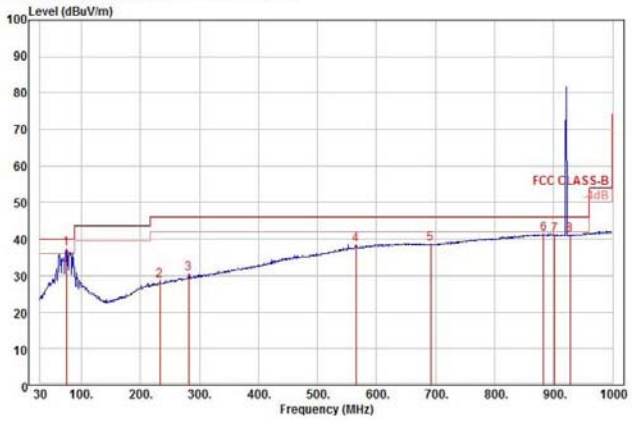
Frequency: 920.6 ㎒

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

Horizontal	Vertical
	
	

Test results (Below 1 000 ㎒)

Distance of measurement: 3 meter
Channel: 1
Frequency: 920.6 ㎒

Horizontal	Vertical
	

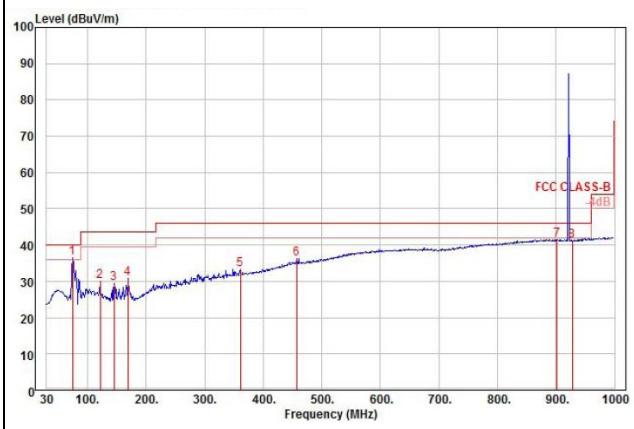
	Freq	Level	Read Level	Ant Factor	Cable Loss	Preamp Factor	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dB/m	dB	dB	dBuV/m	dB		
1 pp	74.62	38.04	28.72	8.47	0.85	0.00	40.00	-1.96		horizontal
2	80.44	37.84	29.80	7.17	0.87	0.00	40.00	-2.16		horizontal
3	212.36	30.56	17.59	11.56	1.41	0.00	43.50	-12.94		horizontal
4	283.17	31.54	16.74	13.03	1.77	0.00	46.00	-14.46		horizontal
5	299.66	31.49	16.27	13.37	1.85	0.00	46.00	-14.51		horizontal
6	460.68	36.61	17.85	16.55	2.21	0.00	46.00	-9.39		horizontal
7	902.03	40.91	15.50	22.15	3.26	0.00	46.00	-5.09		horizontal
8	928.22	41.08	15.53	22.26	3.29	0.00	46.00	-4.92		horizontal

	Freq	Level	Read Level	Ant Factor	Cable Loss	Preamp Factor	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dB/m	dB	dB	dBuV/m	dB		
1 pp	74.62	37.21	27.89	8.47	0.85	0.00	40.00	-2.79		vertical
2	232.73	28.62	15.13	11.98	1.51	0.00	46.00	-17.38		vertical
3	282.20	30.43	15.66	13.01	1.76	0.00	46.00	-15.57		vertical
4	565.44	38.45	17.35	18.54	2.56	0.00	46.00	-7.55		vertical
5	691.54	38.82	16.42	19.67	2.73	0.00	46.00	-7.18		vertical
6	883.60	41.39	16.23	21.92	3.24	0.00	46.00	-4.61		vertical
7	902.03	41.10	15.69	22.15	3.26	0.00	46.00	-4.90		vertical
8	928.22	41.12	15.57	22.26	3.29	0.00	46.00	-4.88		vertical

Note.
1. 902㎒, 928㎒ – Band edge markers.

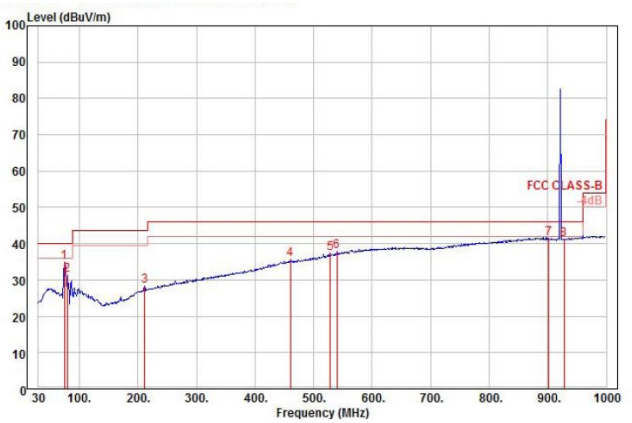
Distance of measurement: 3 meter
Channel: 4
Frequency: 921.2 ㎒

Horizontal



	Freq	Level	Read Level	Ant Factor	Cable Loss	Preamp Factor	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dB/m	dB	dB	dBuV/m	dB		
1 pp	74.62	36.54	27.22	8.47	0.85	0.00	40.00	-3.46		horizontal
2	121.18	30.06	19.15	9.84	1.07	0.00	43.50	-13.44		horizontal
3	145.43	29.43	20.15	8.04	1.24	0.00	43.50	-14.07		horizontal
4	168.71	30.82	20.55	8.93	1.34	0.00	43.50	-12.68		horizontal
5	360.77	33.29	16.54	14.79	1.96	0.00	46.00	-12.71		horizontal
6	456.80	36.14	17.44	16.50	2.20	0.00	46.00	-9.86		horizontal
7	902.03	41.50	16.09	22.15	3.26	0.00	46.00	-4.50		horizontal
8	928.22	41.20	15.65	22.26	3.29	0.00	46.00	-4.80		horizontal

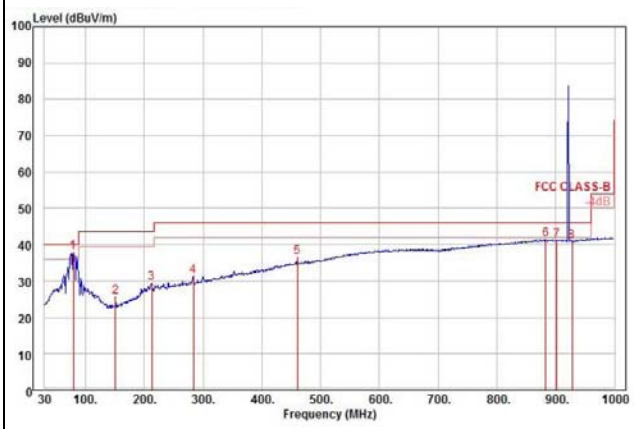
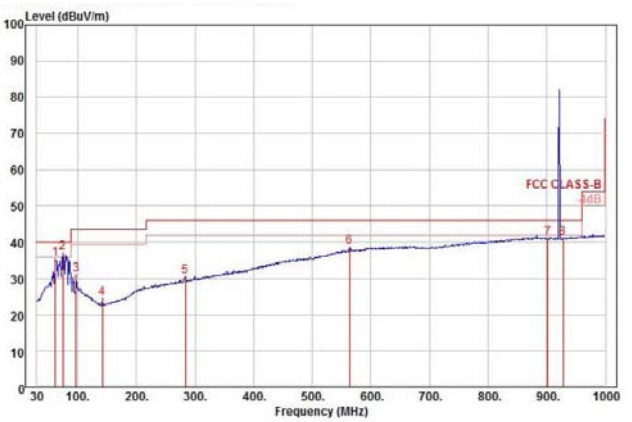
Vertical



	Freq	Level	Read Level	Ant Factor	Cable Loss	Preamp Factor	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dB/m	dB	dB	dBuV/m	dB		
1	74.62	34.91	25.59	8.47	0.85	0.00	40.00	-5.09		vertical
2	79.47	31.23	23.16	7.20	0.87	0.00	40.00	-8.77		vertical
3	211.39	28.42	15.48	11.54	1.40	0.00	43.50	-15.08		vertical
4	460.68	35.59	16.83	16.55	2.21	0.00	46.00	-10.41		vertical
5	528.58	37.45	17.24	17.73	2.48	0.00	46.00	-8.55		vertical
6	540.22	37.76	17.25	17.98	2.53	0.00	46.00	-8.24		vertical
7 pp	902.03	41.38	15.97	22.15	3.26	0.00	46.00	-4.62		vertical
8	928.22	41.06	15.51	22.26	3.29	0.00	46.00	-4.94		vertical

Note.
1. 902㎒, 928㎒ – Band edge markers.

Distance of measurement: 3 meter
Channel: 8
Frequency: 922.0 ㎒

Horizontal	Vertical
	

	Freq	Level	Read Level	Ant Factor	Cable Loss	Preamp Factor	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dB/m	dB	dB	dBuV/m	dB		
1 pp	79.47	37.90	29.83	7.20	0.87	0.00	40.00	-2.10		horizontal
2	151.25	25.73	16.22	8.24	1.27	0.00	43.50	-17.77		horizontal
3	212.36	29.50	16.53	11.56	1.41	0.00	43.50	-14.00		horizontal
4	283.17	31.32	16.52	13.03	1.77	0.00	46.00	-14.68		horizontal
5	460.68	36.43	17.67	16.55	2.21	0.00	46.00	-9.57		horizontal
6	883.60	41.46	16.30	21.92	3.24	0.00	46.00	-4.54		horizontal
7	902.03	41.22	15.81	22.15	3.26	0.00	46.00	-4.78		horizontal
8	928.22	40.97	15.42	22.26	3.29	0.00	46.00	-5.03		horizontal

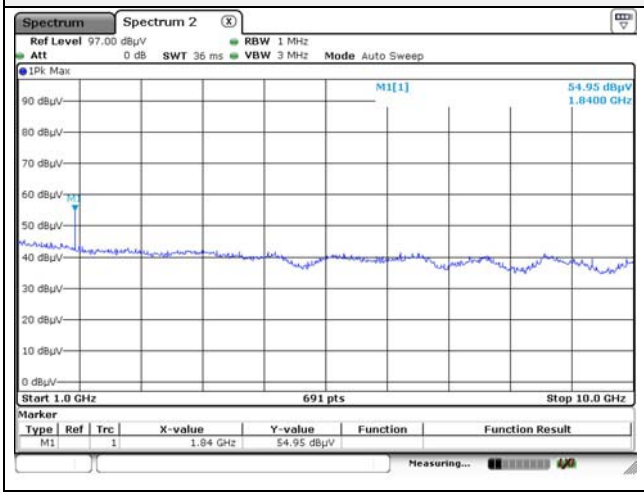
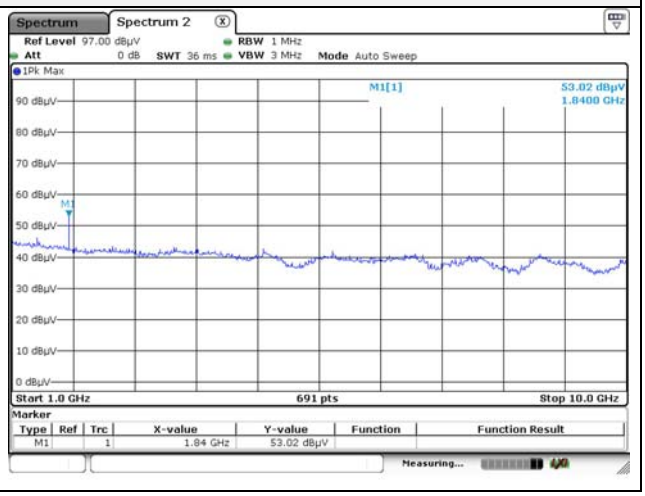
	Freq	Level	Read Level	Ant Factor	Cable Loss	Preamp Factor	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dB/m	dB	dB	dBuV/m	dB		
1	62.01	35.46	22.61	12.08	0.77	0.00	40.00	-4.54		vertical
2 pp	74.62	37.12	27.80	8.47	0.85	0.00	40.00	-2.88		vertical
3	96.93	31.11	19.12	11.00	0.99	0.00	43.50	-12.39		vertical
4	141.55	24.63	15.51	7.90	1.22	0.00	43.50	-18.87		vertical
5	283.17	30.60	15.80	13.03	1.77	0.00	46.00	-15.40		vertical
6	563.50	38.63	17.57	18.50	2.56	0.00	46.00	-7.37		vertical
7	902.03	41.04	15.63	22.15	3.26	0.00	46.00	-4.96		vertical
8	928.22	41.25	15.70	22.26	3.29	0.00	46.00	-4.75		vertical

Note.
1. 902㎒, 928㎒ – Band edge markers.

Test results (Above 1 000 ㎒)

Distance of measurement: 3 meter
Channel: 1
Frequency: 920.6 ㎒

Frequency (㎒)	Level (dB㎶)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1840.00	54.95	Peak	H	-5.48	-	49.47	74.00	24.53
1840.00	53.02	Peak	V	-5.48	-	47.54	74.00	26.46

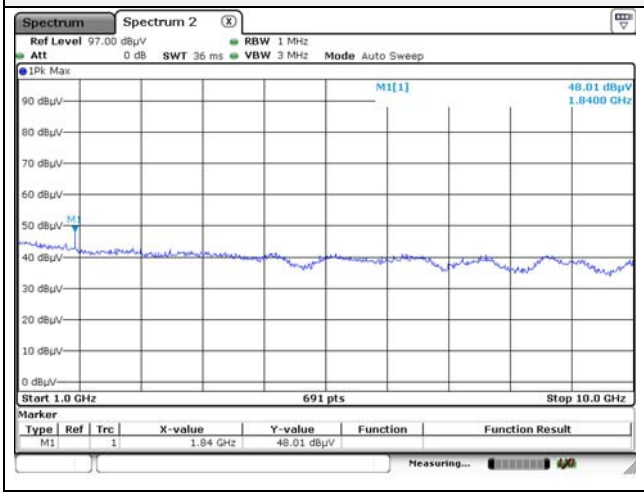
Horizontal // Peak for 1 ㎓ to 10 ㎓	Vertical // Peak for 1 ㎓ to 10 ㎓
	

Note.
1. Average test would be performed if the peak result were greater than the average limit.

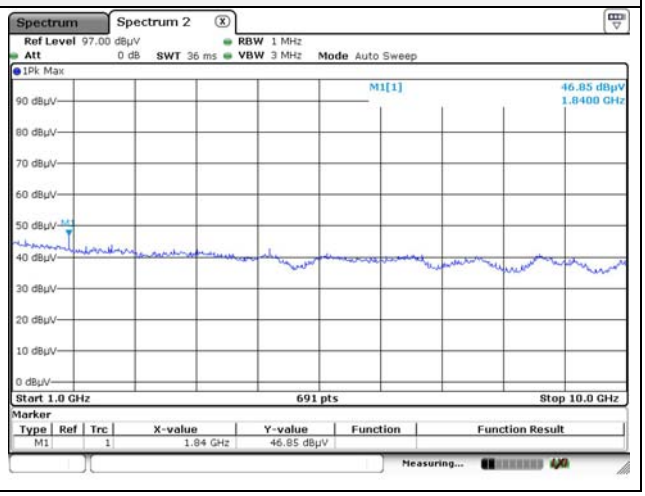
Distance of measurement: 3 meter
Channel: 4
Frequency: 921.2 ㎒

Frequency (㎒)	Level (dB㎶)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1840.00	48.01	Peak	H	-5.48	-	42.53	74.00	31.47
1840.00	46.85	Peak	V	-5.48	-	41.37	74.00	32.63

Horizontal // Peak for 1 ㎓ to 10 ㎓



Vertical // Peak for 1 ㎓ to 10 ㎓



Note.

1. Average test would be performed if the peak result were greater than the average limit.

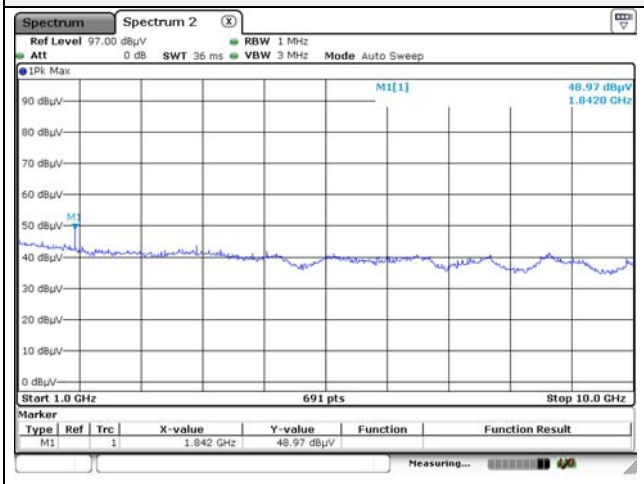
Distance of measurement: 3 meter

Channel: 8

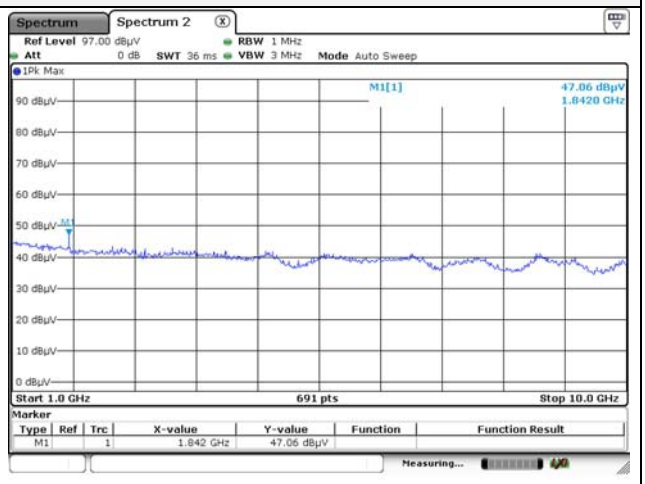
Frequency: 922.0 ㎒

Frequency (㎒)	Level (dB㎶)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1842.00	48.97	Peak	H	-5.46	-	43.51	74.00	30.49
1842.00	47.06	Peak	V	-5.46	-	41.60	74.00	32.40

Horizontal // Peak for 1 ㎓ to 10 ㎓



Vertical // Peak for 1 ㎓ to 10 ㎓



Note.
1. Average test would be performed if the peak result were greater than the average limit.

Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	100736	1 year	2017.07.06
Spectrum Analyzer	R&S	FSV40	101002	1 year	2017.07.06
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2018.01.23
Attenuator	Keysight	8493C	82506	1 year	2018.01.23
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	E/L	3117	135889	2 years	2018.10.25
High Pass Filter	WAINWRIGHT INSTRUMENT	WHJS3000-10TT	1	1 year	2017.07.04
Low Pass Filter	WEINSCHEL	WLK1.0/18G-10TT	1	1 year	2017.07.04
Preamplifier	HP	8449B	3008A00538	1 year	2017.07.05
Preamplifier	SCHWARZBECK	BBV-9718	9718-246	1 year	2017.10.14
EMI Test Receiver	R&S	ESR3	101781	1 year	2017.05.03
EMI Test Receiver	R&S	ESU26	100552	1 year	2017.04.24
EMI Test Receiver	R&S	ESR3	101783	1 year	2017.05.03

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook Computer	Samsung Electronics Co., Ltd.	NP-QX411L	HJV993BB905283V
Test Board	N/A	N/A	N/A