



# TEST REPORT

## Part 15 Subpart C 15.247

**Equipment under test** 802.11abgn, USB module  
**Model name** WUBR-508N  
**FCC ID** RYK-WUBR508N  
**Applicant** SprakLAN Communications, Inc.  
**Manufacturer** SprakLAN Communications, Inc.  
**Date of test(s)** 2019.08.05 ~ 2019.08.16  
**Date of issue** 2019.11.13

**Issued to**  
**SprakLAN Communications, Inc.**  
 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493, Taiwan  
 Tel: +02-2659-1800 / Fax: +02-2659-5538

**Issued by**  
**KES Co., Ltd.**  
 3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,  
 Gyeonggi-do, 14057, Korea  
 473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea  
 Tel: +82-31-425-6200 / Fax: +82-31-424-0450

Test and report completed by :	Report approval by :
	
Yeong-Jun, Cho Test engineer	Hyeon-Su, Jang Technical manager

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
 The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
 The authenticity of the test report, contact shchoi@kes.co.kr

**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 2 ) of ( 31 )

**Revision history**

Revision	Date of issue	Test report No.	Description
-	2019.11.13	KES-RF-19T0180	Initial

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr



## KES Co., Ltd.

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 3 ) of ( 31 )

## TABLE OF CONTENTS

1.	General information .....	4
1.1.	EUT description.....	4
1.2.	Test configuration .....	5
1.3.	Device modifications .....	5
1.4.	Accessory information .....	5
1.5.	Measurement results explanation example.....	5
1.6.	Measurement Uncertainty .....	5
1.7.	Frequency/channel operations .....	6
1.8.	Worst case data rate.....	6
1.9.	Host model information.....	6
2.	Summary of tests .....	7
3.	Test results .....	8
3.1.	Output power .....	8
3.2.	Radiated restricted band and emissions.....	10
Appendix A.	Measurement equipment .....	25
Appendix B.	Test setup photos.....	26
Appendix C.	EUT photos.....	27

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr



## KES Co., Ltd.

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 4 ) of ( 31 )

### 1. General information

Applicant: SprakLAN Communications, Inc.  
Applicant address: 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493, Taiwan  
Test site: KES Co., Ltd.  
Test site address: 3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,  
Gyeonggi-do, 14057, Korea  
473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea  
FCC rule part(s): 15.247  
FCC ID: RYK-WUBR508N  
Test device serial No.: ☒ Production ☐ Pre-production ☐ Engineering

#### 1.1. EUT description

Equipment under test 802.11abgn, USB module  
Frequency range 2 412 MHz ~ 2 462 MHz (11b/g/n\_HT20)  
2 422 MHz ~ 2 452 MHz (11n\_HT40)  
UNII-1 5 180 MHz ~ 5 240 MHz (11a/n\_HT20)  
5 190 MHz ~ 5 230 MHz (11n\_HT40)  
UNII-2A 5 260 MHz ~ 5 320 MHz (11a/n\_HT20)  
5 270 MHz ~ 5 310 MHz (11n\_HT40)  
UNII-2C 5 500 MHz ~ 5 720 MHz (11a/n\_HT20)  
5 510 MHz ~ 5 710 MHz (11n\_HT40)  
UNII-3 5 745 MHz ~ 5 825 MHz (11a/n\_HT20)  
5 755 MHz ~ 5 795 MHz (11n\_HT40)  
Model: WUBR-508N  
Modulation technique DSSS, OFDM  
Number of channels 2 412 MHz ~ 2 462 MHz (11b/g/n\_HT20) : 11ch  
2 422 MHz ~ 2 452 MHz (11n\_HT40) : 7 ch  
5 180 MHz ~ 5 240 MHz (11a/n\_HT20) : 4ch  
5 190 MHz ~ 5 230 MHz (11n\_HT40) : 2ch  
5 260 MHz ~ 5 320 MHz (11a/n\_HT20) : 4ch  
5 270 MHz ~ 5 310 MHz (11n\_HT40) : 2ch  
5 500 MHz ~ 5 720 MHz (11a/n\_HT20) : 12ch  
5 510 MHz ~ 5 710 MHz (11n\_HT40) : 6ch  
5 745 MHz ~ 5 825 MHz (11a/n\_HT20) : 5ch  
5 755 MHz ~ 5 795 MHz (11n\_HT40) : 2ch  
Antenna specification Antenna type(2.4 GHz WIFI) : PCB antenna, Peak gain : -3.6 dBi  
Antenna type(5 GHz WIFI) : PCB antenna, Peak gain : 0.7 dBi  
Power source DC 3.30 V

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr

## 1.2. Test configuration

The **SprakLAN Communications, Inc. // WUBR-508N // FCC ID: RYK-WUBR508N , IC : 6158A-WUBR508N** was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15.247  
RSS-247 Issue 2 and RSS-Gen Issue 5  
KDB 558074 D01 v05 r02  
ANSI C63.10-2013

## 1.3. Device modifications

N/A

## 1.4. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
USB C-type Gender	-	-	-	-
MEDICAL AC/DC ADAPTOR	Shenzhen Megmeet Electronical Co., Ltd.	MANGO60S-USB-PDA	-	-

## 1.5. Measurement results explanation example

For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 1.56 + 10 = 11.56 \text{ (dB)}\end{aligned}$$

## 1.6. Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.62 dB
Uncertainty for Radiation emission test (include Fundamental emission)	9kHz - 30MHz	4.54 dB
	30MHz - 1GHz	4.36 dB
	Above 1GHz	5.00 dB
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		

**1.7. Frequency/channel operations**

Ch.	Frequency (MHz)	Mode
01	2412	802.11b/g/n_HT20
.	.	.
06	2437	802.11b/g/n_HT20
.	.	.
11	2462	802.11b/g/n_HT20

Ch.	Frequency (MHz)	Mode
03	2422	802.11n_HT40
.	.	.
06	2437	802.11n_HT40
.	.	.
09	2452	802.11n_HT40

**1.8. Worst case data rate**

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

**1.9. Host model information**

Host model No. EVS 4343W  
Derived model (s) EVS 4343WG, EVS 4343WP, EVS3643WP, EVS 3643W, EVS 3643WG  
Applicant DRTECH Corporation  
Address Suite No.1, 1Floor / Suite No.2 3Floor, 29, Dunchon-daero 541 beon- gil, Jungwon-  
gu, Seongnam-si, Gyeonggi-do, 13216, Korea  
Telephone +82-31-779-7784  
Fax +82-31-779-7790  
E-mail mwkim@drtech.co.kr  
Contact name Minwoo Kim  
Manufacturer DRTECH Corporation  
Manufacturer Address Suite No.1, 1Floor / Suite No.2 3Floor, 29, Dunchon-daero 541 beon- gil, Jungwon-  
gu, Seongnam-si, Gyeonggi-do, 13216, Korea

**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 7 ) of ( 31 )

**2. Summary of tests**

Section in FCC Part 15	Section in RSS-247 & Gen	Parameter	Test results
-	RSS-Gen 6.7	99% occupied bandwidth	N/A <sup>1)</sup>
15.247(a)(2)	RSS-247 5.2 (a)	6 dB bandwidth	N/A <sup>1)</sup>
15.247(b)(3)	RSS-247 5.4 (d)	Output power	Pass
15.247(e)	RSS-247 5.2 (b)	Power spectral density	N/A <sup>1)</sup>
15.205 15.209	RSS-247 5.5 RSS-Gen 8.9, 8.10	Radiated restricted band and emission	Pass
15.247(d)	RSS-247 5.5	Conducted spurious emission and band edge	N/A <sup>1)</sup>
15.207(a)	RSS-Gen 8.8	AC conducted emissions	N/A <sup>1)</sup>

**Note :**

- 1) Please Refer to the approved Module Report (Report No.: FR232843AC) for these parameters.

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr

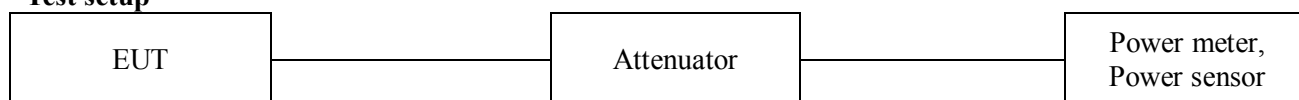
### 3. Test results

#### 3.1. Output power

##### Test procedure

ANSI C63.10-2013 - Section 11.9.1.3 and 11.9.2.3.2

##### Test setup



##### ANSI C63.10-2013 - Section 11.9.1.3

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 bandwidth and shall use a fast-responding diode detector.

##### ANSI C63.10-2013 - Section 11.9.2.3.2

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. Because the 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 MHz, 2 400~2 483.5 MHz, and 5 725~5 850 MHz 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 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi 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 dBi.

According to RSS-247 5.4 (d), For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in Section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is 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 transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.



**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 9 ) of ( 31 )

**Test results**

Measured output power (dBm)			
Mode	2 412 MHz	2 437 MHz	2 462 MHz
	Average	Average	Average
11b	19.67	19.43	18.28
11g	15.80	15.70	14.66
11n_HT 20	14.89	14.28	14.75

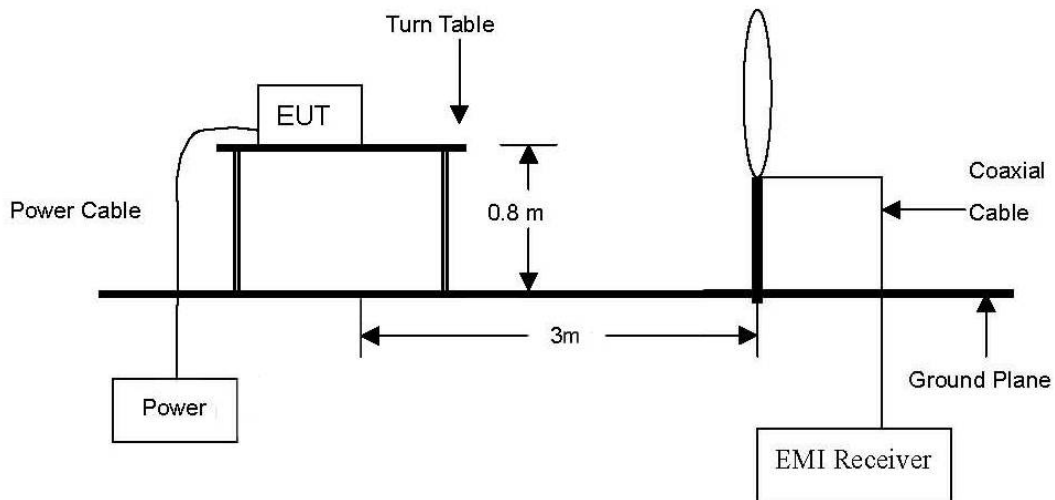
Measured output power (dBm)			
Mode	2 422 MHz	2 437 MHz	2 452 MHz
	Average	Average	Average
11n_HT 40	12.30	12.28	12.96

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr

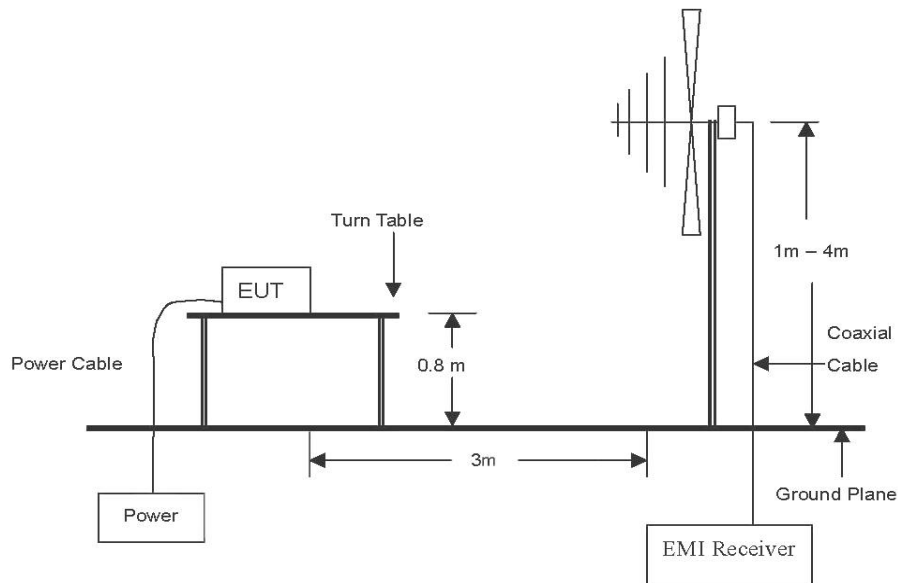
### 3.2. Radiated restricted band and emissions

#### Test setup

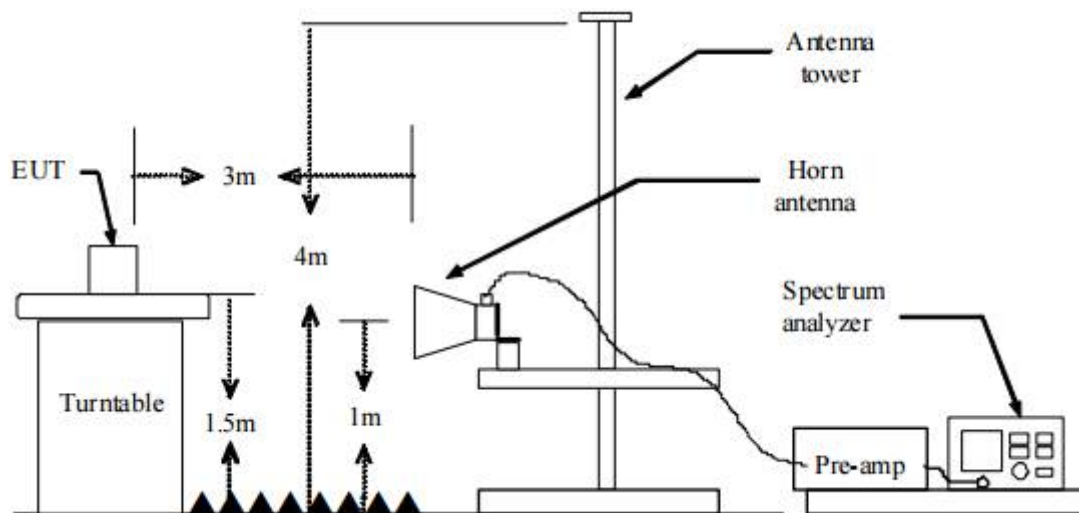
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



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



### Test procedure

Radiated emissions from the EUT were measured according to the dictates in section 11.11 & 11.12 of ANSI C63.10-2013.

#### Test procedure below 30 MHz

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, ground parallel and perpendicular of the antenna are set to make the measurement. It was determined that parallel was worst-case orientation; therefore, all final radiated testing was performed with the EUT in parallel.
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 MHz

1. The EUT was placed on the top of a rotating table 1.5 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. The antenna is a bi-log antenna, a horn antenna ,and its height are varied from one meter to four 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.
3. 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.
4. The test receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

5. Spectrum analyzer settings for  $f < 1$  GHz:

- ① Span = wide enough to fully capture the emission being measured
- ② RBW = 100 kHz
- ③ VBW  $\geq$  RBW
- ④ Detector = quasi peak
- ⑤ Sweep time = auto
- ⑥ Trace = max hold

6. Spectrum analyzer settings for  $f \geq 1$  GHz: Peak

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW  $\geq 3$  MHz
- ④ Detector = peak
- ⑤ Sweep time = auto
- ⑥ Trace = max hold
- ⑦ Trace was allowed to stabilize

7. Spectrum analyzer settings for  $f \geq 1$  GHz: Average

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW  $\geq 3 \times$  RBW
- ④ Detector = RMS, if  $\text{span}/(\# \text{ of points in sweep}) \leq (\text{RBW}/2)$ . 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 dB 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 ( $\geq 98$  percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

**Note.**

- $f < 30$  MHz, extrapolation factor of 40 dB/decade of distance.  $F_d = 40\log(D_m/D_s)$   
 $f \geq 30$  MHz, extrapolation factor of 20 dB/decade of distance.  $F_d = 20\log(D_m/D_s)$   
Where:  
 $F_d$  = Distance factor in dB  
 $D_m$  = Measurement distance in meters  
 $D_s$  = Specification distance in meters
- Field strength(dB $\mu$ V/m) = Level(dB $\mu$ V) + CF (dB) + or DCF(dB)
- Margin(dB) = Limit(dB $\mu$ V/m) - Field strength(dB $\mu$ V/m)
- Emissions below 18 GHz were measured at a 3 meter test distance while emissions above 18 GHz were measured at a 1 meter test distance with the application of a distance correction factor.
- 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**.
- The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
- According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field 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 (MHz)	Distance (Meters)	Radiated ( $\mu$ V/m)
0.009 ~ 0.490	300	2400/F(kHz)
0.490 ~ 1.705	30	24000/F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

\*\*Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 MHz, 76 ~ 88 MHz, 174 ~ 216 MHz or 470 ~ 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 14 ) of ( 31 )

According to RSS-Gen, Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits :

Frequency (MHz)	Distance (Meters)	Radiated ( $\mu\text{W/m}$ )
0.009 ~ 0.490	300	2 400 / F(kHz)
0.490 ~ 1.705	30	24 000 / F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100
88 ~ 216	3	150
216 ~ 960	3	200
Above 960*	3	500

\* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

**Note:** Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr

### Duty cycle

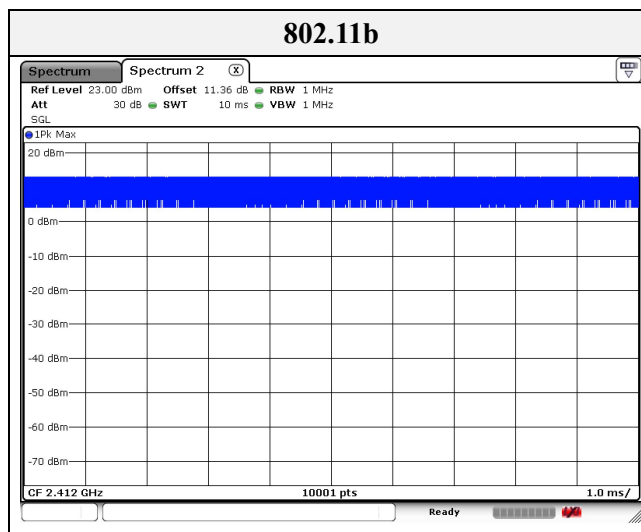
Regarding to KDB 558074 D01\_v05 r02, 6. Measurements of duty cycle and transmission duration shall be performed using one of the following techniques:

- A diode detector and an oscilloscope that together have sufficiently short response time to permit accurate measurements of the on- and off-times of the transmitted signal.
- The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on- and off-times of the transmitted signal.

Test mode	T <sub>on</sub> time (ms)	Period (ms)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
802.11b	1	1	1	100	0

Duty cycle (Linear) = T<sub>on</sub> time/Period

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





## KES Co., Ltd.

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:

KES-RF-19T0180

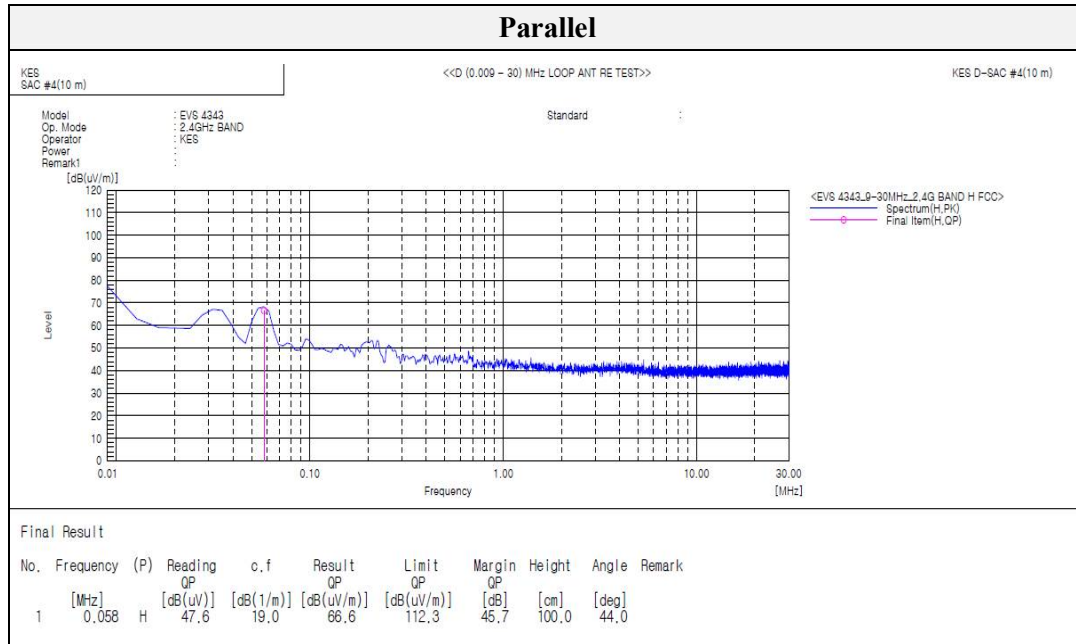
Page ( 16 ) of ( 31 )

### Test results (Below 30 MHz)

Mode: 802.11b

Distance of measurement: 3 meter

Channel: 01 (Worst case)



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr





## KES Co., Ltd.

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:

KES-RF-19T0180

Page ( 17 ) of ( 31 )

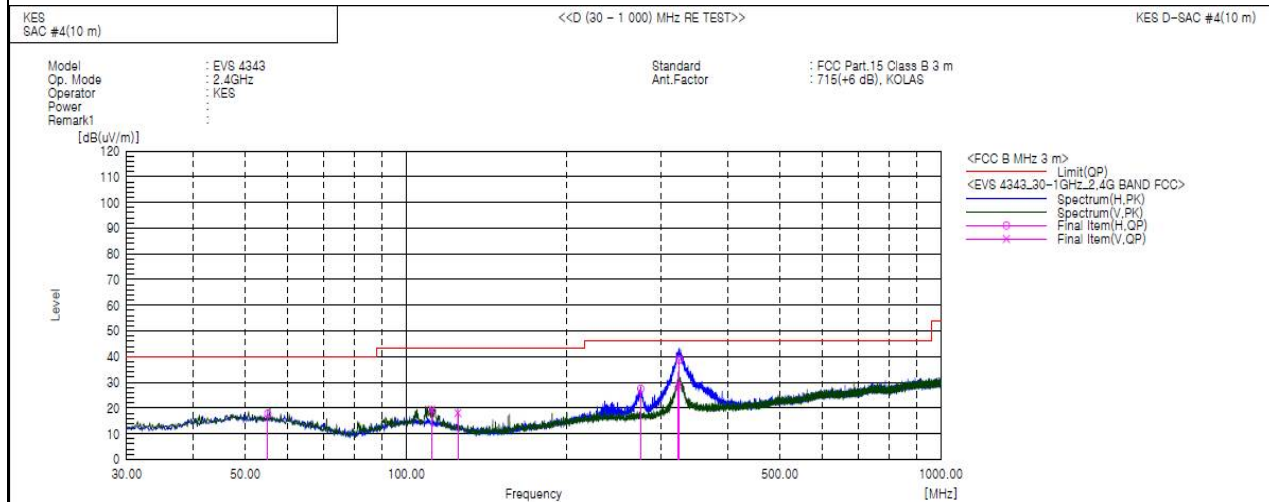
### Test results (Below 1 000 MHz)

Mode: 802.11b

Distance of measurement: 3 meter

Channel: 01 (Worst case)

### Horizontal // Vertical



### Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	55.099	H	40.2	-22.4	17.8	40.0	22.2	100.0	235.0	
2	111.601	V	43.0	-23.6	19.4	43.5	24.1	224.0	200.0	
3	124.939	V	43.6	-25.6	18.0	43.5	25.5	177.0	172.0	
4	274.683	H	48.3	-20.8	27.5	46.0	18.5	154.0	71.0	
5	322.940	V	47.3	-18.6	28.7	46.0	17.3	124.0	69.0	
6	324.395	H	57.3	-18.5	38.8	46.0	7.2	100.0	115.0	

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

The authenticity of the test report, contact shchoi@kes.co.kr

**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 18 ) of ( 31 )

**Test results (Above 1 000 MHz)**

Mode: 802.11b (Worst case)

Distance of measurement: 3 meter

Channel: 01

**- Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 160.60	44.71	Peak	H	24.15	-32.57	-	36.29	74.00	37.71
1 837.90	44.90	Peak	H	27.34	-26.94	-	45.30	74.00	28.70
2 521.00	44.34	Peak	H	29.70	-28.56	-	45.48	74.00	28.52
1 496.40	43.59	Peak	V	25.09	-33.19	-	35.49	74.00	38.51
1 875.50	43.39	Peak	V	27.59	-26.61	-	44.37	74.00	29.63
2 266.30	49.88	Peak	V	29.09	-35.36	-	43.61	74.00	30.39

**- Band edge**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 373.72	43.44	Peak	H	29.36	-36.18	-	36.62	74.00	37.38
2 389.18	45.74	Peak	V	29.40	-36.30	-	38.84	74.00	35.16

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr

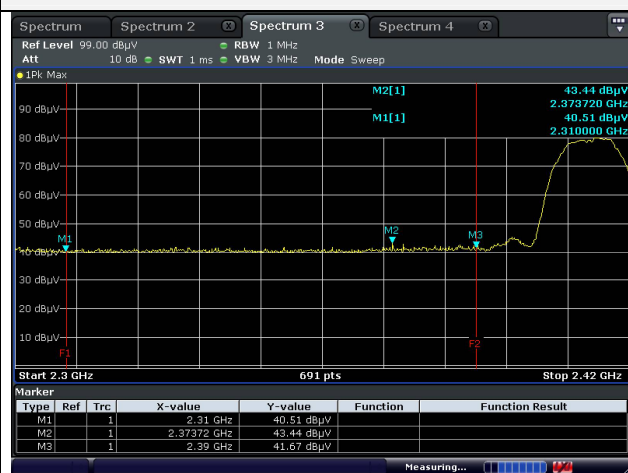


## KES Co., Ltd.

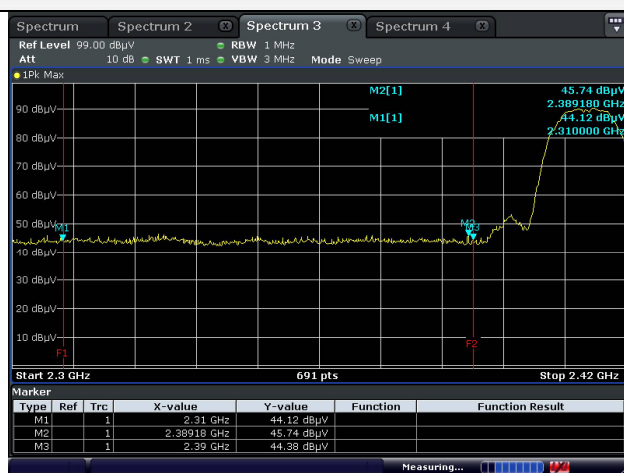
3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 19 ) of ( 31 )

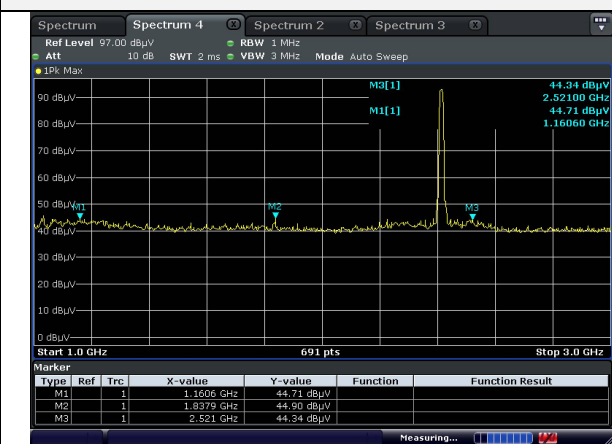
### Restricted band // Horizontal // Peak



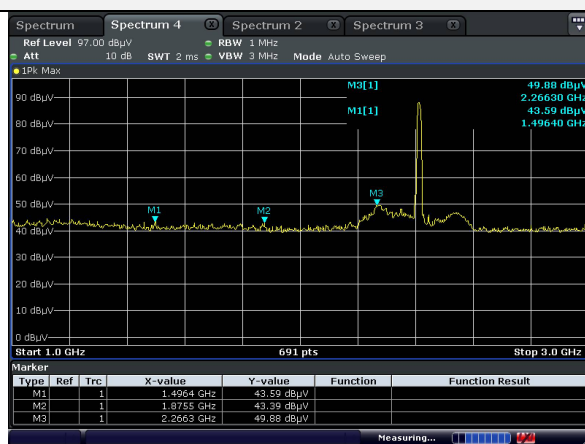
### Restricted band // Vertical // Peak



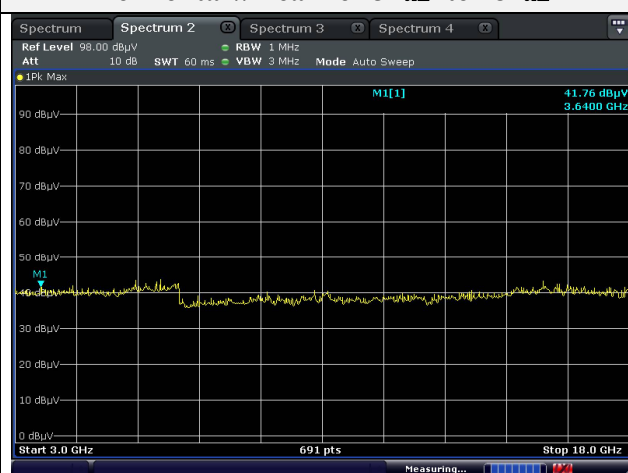
### Horizontal // Peak for 1 GHz to 3 GHz



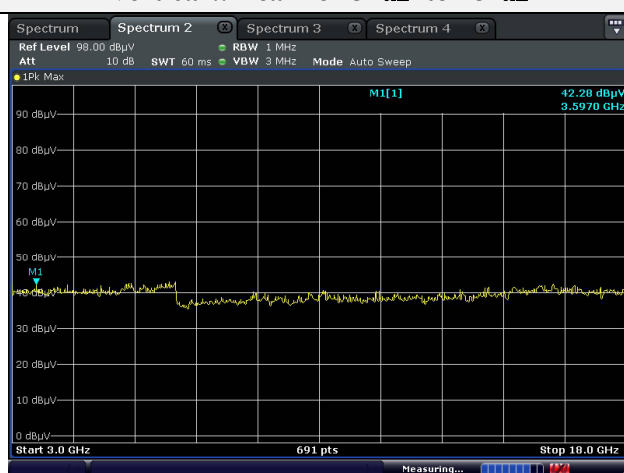
### Vertical // Peak for 1 GHz to 3 GHz



### Horizontal // Peak for 3 GHz to 18 GHz



### Vertical // Peak for 3 GHz to 18 GHz



Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr

**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:

KES-RF-19T0180

Page ( 20 ) of ( 31 )

Mode: 802.11b (Worst case)

Distance of measurement: 3 meter

Channel: 06

**- Spurious**

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
1 198.30	46.47	Peak	H	24.26	-32.66	-	38.07	74.00	35.93
1 840.80	44.79	Peak	H	27.36	-26.92	-	45.23	74.00	28.77
2 590.40	42.33	Peak	H	29.78	-28.58	-	43.53	74.00	30.47
1 152.00	43.73	Peak	V	24.13	-32.55	-	35.31	74.00	38.69
1 849.50	39.97	Peak	V	27.42	-26.84	-	40.55	74.00	33.45
2 382.10	47.19	Peak	V	29.38	-36.25	-	40.32	74.00	33.68

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

The authenticity of the test report, contact shchoi@kes.co.kr

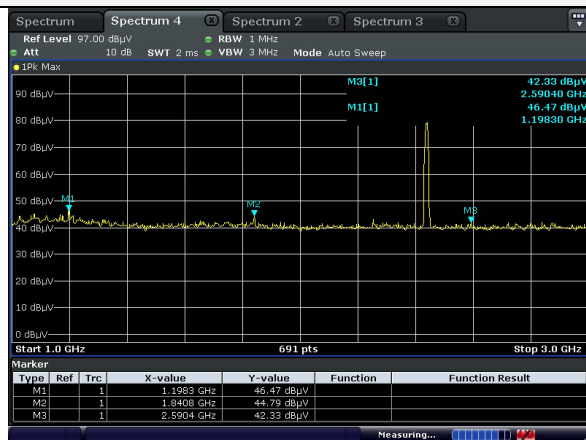


## KES Co., Ltd.

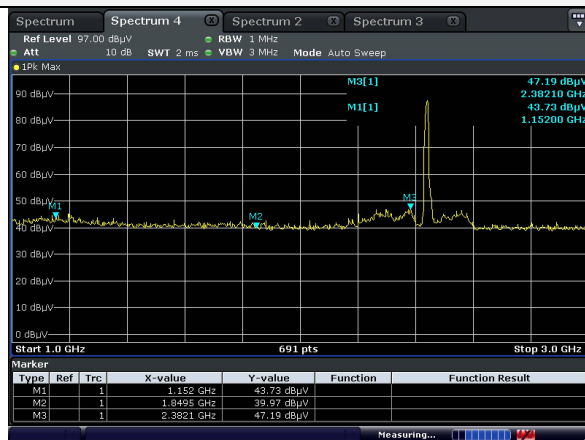
3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 21 ) of ( 31 )

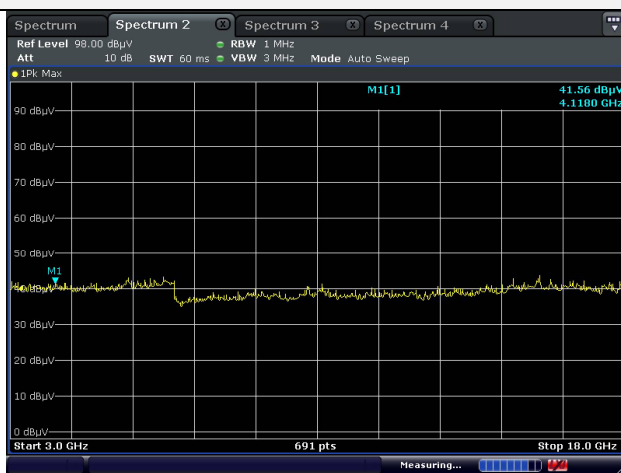
### Horizontal // Peak for 1 GHz to 3 GHz



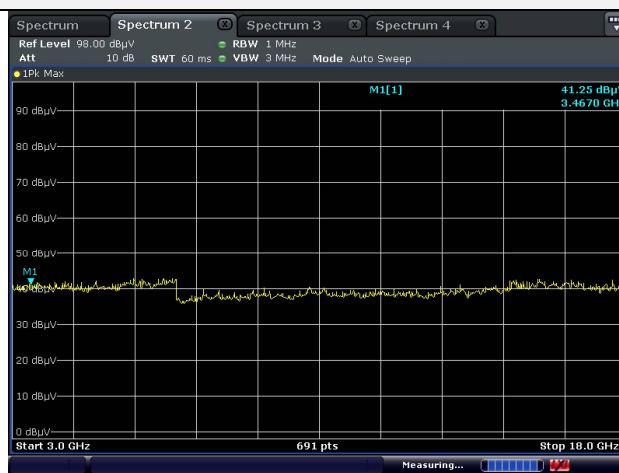
### Vertical // Peak for 1 GHz to 3 GHz



### Horizontal // Peak for 3 GHz to 18 GHz



### Vertical // Peak for 3 GHz to 18 GHz



Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr

**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:

KES-RF-19T0180

Page ( 22 ) of ( 31 )

Mode: 802.11b (Worst case)

Distance of measurement: 3 meter

Channel: 11

**- Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 166.40	44.04	Peak	H	24.17	-32.58	-	35.63	74.00	38.37
1 837.90	42.78	Peak	H	27.34	-26.94	-	43.18	74.00	30.82
2 558.60	43.66	Peak	H	29.75	-28.57	-	44.84	74.00	29.16
1 198.30	44.74	Peak	V	24.26	-32.66	-	36.34	74.00	37.66
1 782.90	39.05	Peak	V	26.98	-27.43	-	38.60	74.00	35.40
2 549.90	42.82	Peak	V	29.74	-28.57	-	43.99	74.00	30.01

**- Band edge**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	AF (dB)	AMP+CL (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 488.00	47.05	Peak	H	29.65	-37.03	-	39.67	74.00	34.33
2 488.00	46.47	Peak	V	29.65	-37.03	-	39.09	74.00	34.91

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

The authenticity of the test report, contact shchoi@kes.co.kr

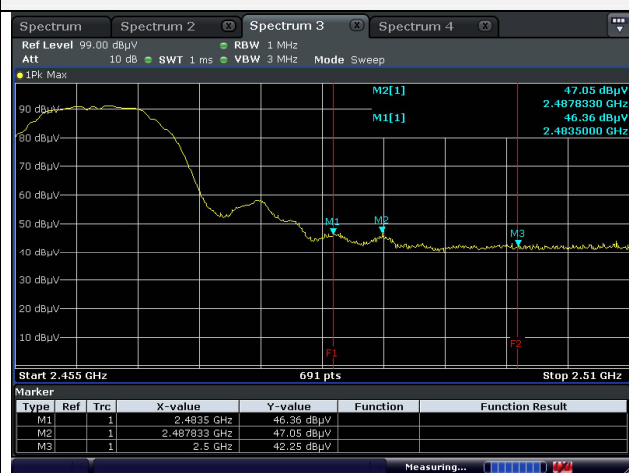


## KES Co., Ltd.

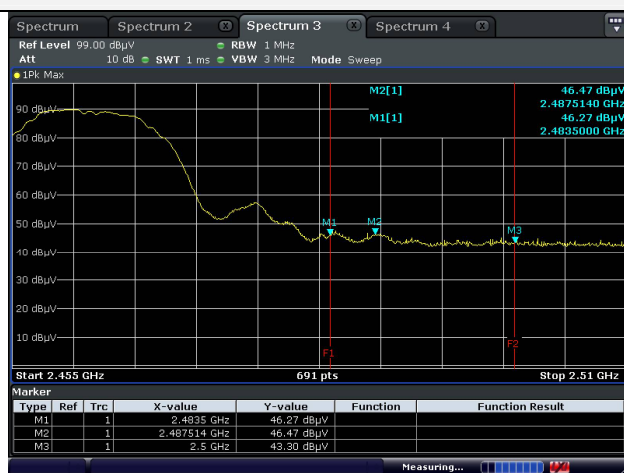
3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 23 ) of ( 31 )

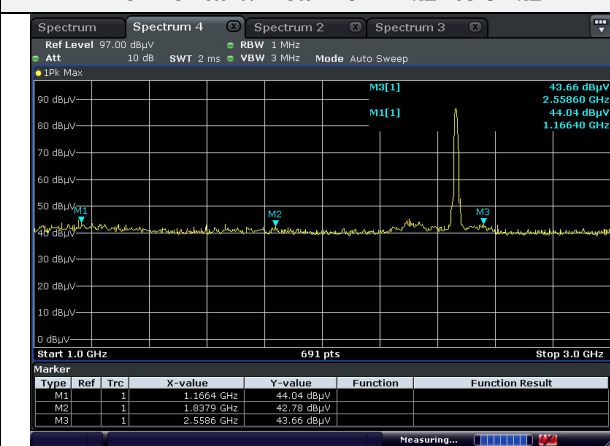
### Restricted band // Horizontal // Peak



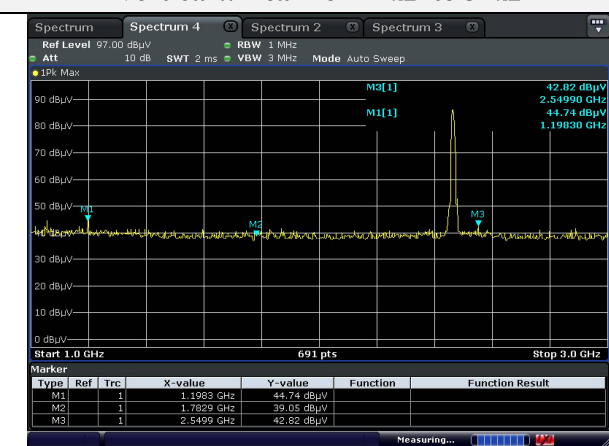
### Restricted band // Vertical // Peak



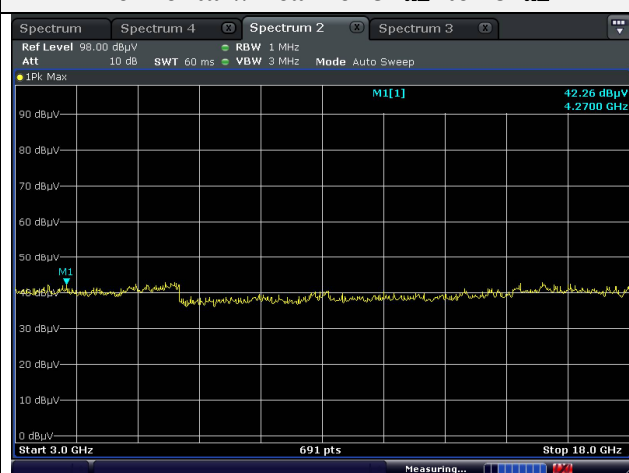
### Horizontal // Peak for 1 GHz to 3 GHz



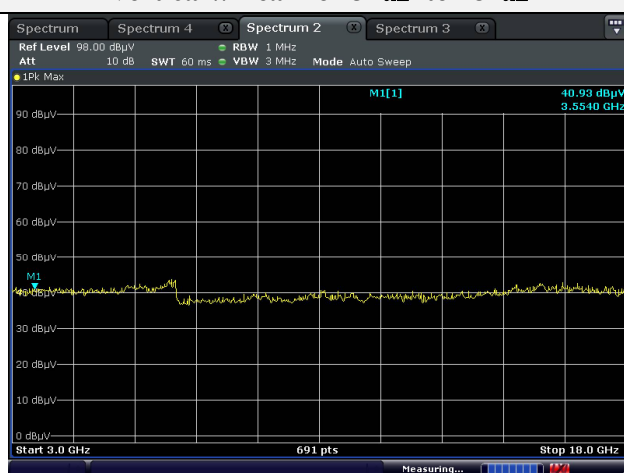
### Vertical // Peak for 1 GHz to 3 GHz



### Horizontal // Peak for 3 GHz to 18 GHz



### Vertical // Peak for 3 GHz to 18 GHz



Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr



## KES Co., Ltd.

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

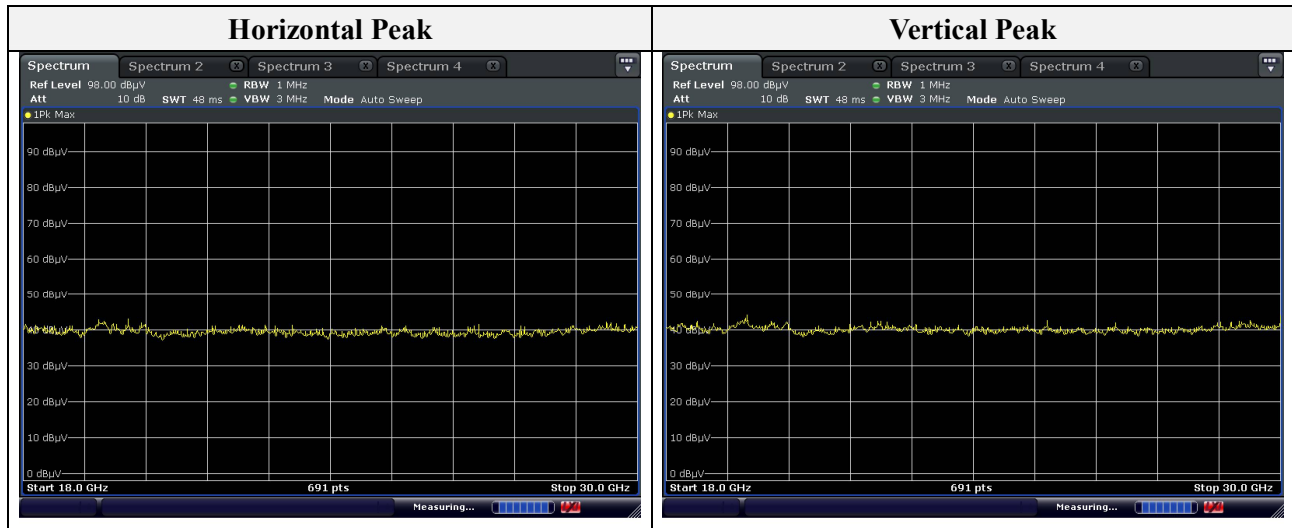
Report No.:  
KES-RF-19T0180  
Page ( 24 ) of ( 31 )

### Test results (18 GHz to 30 GHz) – Worst case

Mode: 802.11b

Distance of measurement: 3 meter

Channel: 1 (Worst case)



Note.

No spurious emission were detected above 18 GHz.

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr



**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:  
KES-RF-19T0180  
Page ( 25 ) of ( 31 )

**Appendix A. Measurement equipment**

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	101389	1 year	2020.01.09
Spectrum Analyzer	R&S	FSV40	101002	1 year	2020.06.24
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2020.01.15
Vector Signal Generator	R&S	SMBV100A	1407.6004K02	1 year	2020.06.25
Power Meter	Anritsu	ML2495A	1438001	1 year	2020.01.15
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2020.01.15
Attenuator	HP	8494B	2630A12857	1 year	2020.01.15
Attenuator	KEYSIGHT	8493C	82506	1 year	2020.01.15
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2021.02.15
Trilog-broadband antenna	SCHWARZBECK	VULB 9163	715	2 years	2020.09.20
Horn Antenna	A.H	SAS-571	414	2 years	2021.02.11
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA 9170550	2 years	2021.02.19
High Pass Filter	Wainwright Instrument Gmbh	WHJS3000-10TT	1	1 year	2020.06.25
Band Reject Filter	MICRO-TRONICS	BRM50702	G272	1 year	2020.01.16
Low Pass Filter	Wainwright Instrument Gmbh	WLK1.0/18G-10TT	1	1 year	2020.06.24
Broadband Amplifier	Schwarzbeck	BBV9721	PS9721-003	1 year	2020.01.16
Preamplifier	AGILENT	8449B	3008A01742	1 year	2020.01.08
Amplifier	R&S	SCU 01	100603	1 year	2019.11.26
EMI Test Receiver	R&S	ESU26	100551	1 year	2020.04.09
EMI Test Receiver	R&S	ESR3	101781	1 year	2020.04.22
DC Power supply	Agilent	6632B	MY43004090	1 year	2020.06.25
LISN	R&S	ENV216	101786	1 year	2020.01.25
RF Cable #1					
RF Cable #2					

**Peripheral devices**

Device	Manufacturer	Model No.	Serial No.
Notebook Computer	HP	HP-6530B	CNU8313PMW
Test Jig Board	N/A	N/A	N/A

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr